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ROENTGENOLOGIC DIAGNOSIS OF DISEASES OF THE UPPER RESPIRATORY TRACT IN CHILDREN*

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THE roentgenological investigation of the upper respiratory tract must include a collective study of the oropharynx, the neck and the chest. We wish to strongly emphasize the fact that in very young children this wide inclusion of anatomical structures should be adopted as a routine procedure in every chest examination for the reason that many suspected intrathoracic conditions will be explained in part or entirely by obstructive lesions or phenomena higher up. In older children and adults an examination of the neck and cervical portion of the upper respiratory tract is frequently necessary in certain groups of cases, especially in those referred from a bronchoscopic or laryngological clinic. In a few instances an adult neck examination may reveal an unsuspected pathological condition and even save life, hence the insistence of Chevalier Jackson and his associates that the study of the neck and the swallowing function form a part of every routine chest examination. Several years' experience has taught us the wisdom of this policy, and had we not followed it we would not have had the material for this presentation. The subject of the upper respiratory tract has been found to be such a broad one that we have deemed it necessary to limit this paper to the age period of infancy and early childhood. This is perhaps, the most important period for general discussion and for more systematic study of the anatomical structures of the neck and their relations with intrathoracic organs and functions.

Aside from the detection of foreign bodies, our first realization of the great importance of examinations of the neck arose from the diagnosis of retropharyngeal abscesses. Our appreciation of the many diagnostic possibilities in this part of the body became a reality when observing the study of roentgenograms of the neck by Hay[10] in the preparation of his recent monograph on the neck. Our excuse for making any additional presentation of this subject after it has been handled so ably and exhaustively by Hay is the fact that there are many phases of diagnosis in upper respiratory tract conditions that still require further careful study. When one becomes thoroughly familiar with the abundance of diagnostic material to be found in the structures of the neck, he is struck by the failure to find many references in the literature to the roentgenological study of this part of the body. The first suggestion of diagnostic possibilities made by Iglauer[13] in 1914 in his contribution on

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the larynx failed to make any lasting impression. Pfahler's[32] demonstration of the thyroid shadow before the American Roentgen Ray Society in 1921 has evidently escaped the memory of most of us. It is only recently that Hickey,[11] in the presentation of his own work as a part of the 1928 Caldwell lecture, and Brown and Reineke[4] (1928) have shown that active interest is at last being aroused and necessity for careful study of the neck is being realized.

The basis of diagnosis of upper respiratory conditions is rather complex: (1) the soft tissues of the neck surround a more or less rigid air containing passage—the pharynx, larynx, and trachea—which can be visibly encroached upon; (2) a collapsed potential space—the esophagus—can be filled with opaque substances to designate its lumen; (3) the dense vertebrae occupy a fixed relative position for the estimation of displacements and for making comparative measurements of these spaces and their locations; (4) a clear view is easily obtainable of the intrathoracic trachea and its relations, and (5) certain phenomena observable in the chest may be associated with obstruction in the upper air passages. Not only can intrinsic lesions which encroach upon the lumina of the air and food passages be easily determined, but also soft tissue conditions outside which compress or displace these structures. As this presentation deals only with the upper respiratory tract, lesions of the esophagus and spine will not be discussed except as they affect the air passages.

In the very beginning of the study of the neck or upper respiratory tract one is confronted by two very important problems: a uniform and comprehensive technique which is capable of exact reproduction, and the establishment of a normal for different ages.

The exact technique will vary considerably with the age of the individual. The technique for use in adults is more or less an independent one which will not be discussed here. In infants and children it will also vary considerably with the age, but must be an intimate part of the chest technique. In infancy and early childhood, when foreign bodies and the thymus play such an important rôle in diagnosis, our technique has been adapted to all chest examinations, and is, no doubt, one which is rather generally in use, with certain slight modifications. There is always a preliminary roentgenoscopic study made in essentially the same horizontal positions as the roentgenographic views. The sagittal roentgenograms are made on a rather low table in the prone posture with the infant's chest and neck on the cassette. The tube is raised 38 inches above the latter and directly over the suprasternal notch level. One attendant holds the lower extremities

FIG. 1. Chair for examining the chest and neck of infants and young children in the erect posture. (A modification of the chair used for encephalography.) Note that the back is equipped with an adjustable bakelite cassette holder. The child sits on the board resting on the chair arms.

Fig. 2. Infant in position in the chair for vertical posteroanterior chest and neck exposures. The arms and head must be held by hand. The patient must not be allowed to slump.

and hips and another the upper extremities above the head, which must be held exactly straight, without the slightest rotation to either side, and midway between flexion and extension. The exposures are made in 1/20 of a second with 100 ma. of current, but may be made faster with a higher milliamperage. One exposure must be made during expiration and one during inspiration, efforts being made to get them at the peak of each phase. The child is forced to cry because of the greater accuracy of timing the phase and the deeper respiratory effort. The child must be crying lustily and regularly. Sobbing or "catchy" crying renders it difficult to select the exact phases of full inspiration and expiration and the typical respiratory changes in appearance will not be shown. The patient is next placed on one side. The arms are then held *downward and back* so that the shoulders are thrown posteriorly as far as possible. The head should be held firmly and should be so elevated that the neck will be absolutely straight with the body, and it should be in a position exactly between flexion and extension. An exact lateral view is essential. The exposures require about twice the time of the sagittal views. One must be made during expiration and one during inspiration, and, again, at the peak of each phase if possible. The neck is, of course, included. Important conditions may be overlooked unless these two lateral roentgenograms are made. In older children the erect posture becomes more desirable.

Recently we have been experimenting with a combination chair and cassette holder for examining the infants in the erect posture (Figs. 1, 2 and 3). A large number of clinically normal babies from the maternity and pediatric out-patient de-

Fig. 3. Infant in position in the chair for vertical lateral chest and neck exposures. Note the positions in which the arms and head are held.

partments have been examined by both the prone and the erect techniques in order to reach a definite conclusion as to which may be the more desirable for general use in detecting pathological conditions, especially as we believe that the thymus is still a structure which has not been examined in a satisfactory manner as a rule.

As a result of these studies, we have come to the conclusion that in infants and young children the examinations should be made in both the erect and prone positions. We believe now that better roentgenograms can be made in the erect posture, but as the child usually lies on the abdomen or back we shall continue to make exposures in the horizontal position as well, in order to obtain as nearly as possible a true idea of the usual postural anatomical relationships or until we are satisfied that this part of the examination is not necessary. Further reason for this will be found in connection with the discussion on the thymus. This means considerable work, but it is worth while if we are to be accurate in our deductions.

In an effort to overcome the shortcomings of the thymic examination as it has been carried on in the past, and to establish, if possible, an arbitrary standard whereby one can be justified in rendering an authoritative opinion upon normal findings and abnormal encroachments upon the spaces in the upper chest and neck, we have undertaken the examination of the series of presumably normal infants in both the erect and horizontal positions. As it is exceedingly difficult to examine a young child in the erect posture under ordinary conditions, we had an adaptable chair made for the purpose (Figs. 1, 2 and 3).

This chair, a modification of the chair for encephalography previously described by one of us,[31] is, of necessity, for the two purposes, a large one upon which broad wheel casters have been placed in order to facilitate movement when not in use. A door stop was placed on each leg so that the chair can be made absolutely stationary when desirable. The back of the chair is easily movable up and down in order to make it flexible as to height for children of various ages. This part of the chair also contains a bakelite cassette holder. A restraining band of the usual commercial type is attached to the outer sides of the erect arms of the back in order to aid in holding the child erect and against the cassette holder (Figs. 1, 2 and 3). An attendant must hold the arms and head of the child. As the babies must be held by hand in both methods of examination as well as during roentgenoscopy, it is not wise to have any of the regular members of the staff do this continuously, hence the nurse bringing the patient or the pupil nurses who are with us for a short time only are designated for this purpose. The distance and other exposure factors are essentially the same as for the horizontal technique.

In the erect posteroanterior position the arms are held up on either side of the head and great care must be taken to have the body symmetrical, so that the resulting roentgenograms will show the sternal ends of the clavicles equidistant from the spine and the trachea in the midline (Fig. 2). In the lateral views the head must be held so that it does not fall to either side and is at a midpoint between flexion and extension. The arms must be held back of the patient as in the horizontal technique, and the head placed with the same care (Fig. 3). As stated above, we believe that the examination of the infant in the erect posture should be an integral part of the technique for enlarged thymus but should not be carried out to the exclusion of the study in the horizontal position. McLean[23] and Remer and Belden[33] have been convinced of the advisability of the examination in the erect posture and are largely responsible for stimulating us in our work on this problem. Remer and Belden have described a technique similar to ours. Kinney and Taylor,[19] among others, have seen no particular advantage in it.

Fig. 4.

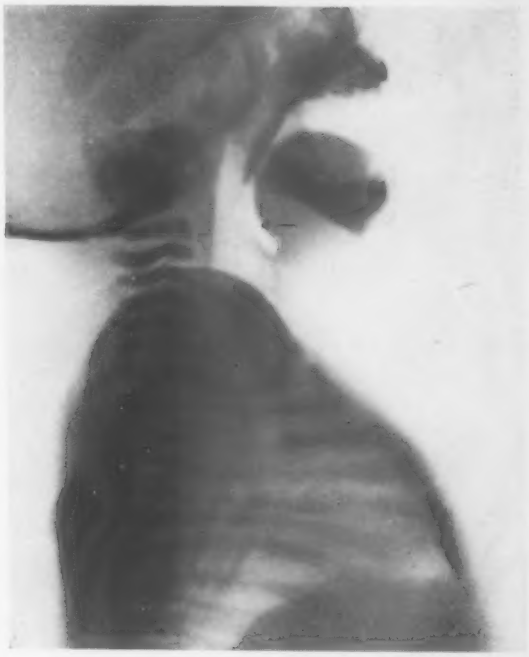

Fig. 5.

Figs. 4 and 5. Showing the variable thickness of the shadow of the postpharyngeal tissues on expiration and inspiration. Male, aged eighteen days. Fig. 4. Expiration. Fig. 5. Inspiration. At an examination made two days before for supposed enlarged thymus, no enlargement was found, but the two lateral views were incorrectly timed as to phase, and both were made at expiration. This made us suspect retropharyngeal abscess because we were not familiar with the differences in appearance at the two phases. This examination shows both phases correctly and not only eliminated abscess but taught us this sign by which the two phases can be differentiated, provided the child is crying regularly.

The study of the normal chest and neck is of little value unless undertaken in a comprehensive manner upon clinically normal subjects. Such studies have been carried out by many individuals in connection with the chest, notably the Normal Chest Committee of the National Tuberculosis Association,[30] Farrell,[7] and Wasson.[38]

Much of our knowledge of the normal neck was established through the collective studies made by Hay.[10] He has presented an admirable roentgenographic interpretation based upon the structural anatomy of this part of the body. With the exception of the detection and localization of opaque foreign bodies, nearly all of the information of pathological conditions is to be gained from the lateral view. As a great part of this information depends upon encroachment on the lumen of or displacement of the pharynx, larynx, and trachea, such deformities or abnormalities of these air passages must be estimated by the space between their posterior walls and the anterior surfaces of the bodies of the cervical vertebrae. This space and the lumen will vary normally with age, degree of flexion of the neck and the phase of respiration during forced expiration and inspiration of crying (Figs. 4 and 5). The phase of respiration has the most marked effect upon the lumen of the pharynx, and to a less extent upon that of the trachea. The rigid cartilaginous structure of the larynx prevents changes in the lumen of that portion of the passage. It is known through bronchoscopic observation that the tracheal lumen also changes decidedly, but this is not indicated to any great extent by roentgenological study. Hay[10] has

Fig. 6. Lateral view of the normal neck of a female, aged twenty-one years. The following structures are distinguishable: posterior border of tongue; body and greater cornua of hyoid bone; epiglottis, overlapping the latter; epiglottic vallecula; pharynx (note posterior wall paralleling the vertebral bodies and thickness compared to the body of the fifth cervical vertebra); arytenoids are not well shown in this case, but can be made out; aryepiglottic folds show very faintly; pyriform sinuses can be located approximately; laryngeal vestibule below the epiglottic shadow; anterior wall of the vestibule; ventricular folds; vocal cords; laryngeal ventricles between the two latter structures; trachea; apex of lung back of lower part of trachea.

proposed a very admirable method of obtaining the approximate deviation from the normal in the retropharyngeal and retrotracheal spaces by the use of the ossified portion of the body of the fifth cervical vertebra as the index of measurement. This vertebral width he arbitrarily designates as "c." He states that with the pharynx *at rest* the distance between its posterior surface and the osseous portion of adjacent vertebrae measures at the level of the epiglottic vallecula approximately as follows:

First year, never over 1.5 c
First to third year, never over 0.5 c
Third to sixth year, never over 0.4 c
Sixth to fourteenth year, never over 0.3 c

In adults the *average* measurement is as follows:

Males, 0.2 c
Females, 0.1 c

It will be noted that these measurements in infants and young children are made with the pharynx at rest and not during crying, although the author calls attention to the fact that they will vary with crying. Our present technique including the two lateral roentgenograms made during the forced expiratory and inspiratory phases of crying shows a considerable difference in the measurements at these two periods (Figs. 4 and 5). Our average measurements of 78 infants during the first year, all of which were examined at the ages of two and twelve days and a few at six months have

Fig. 7. Lateral view of the neck of a male child aged seven years. The following structures are easily seen: the pharynx, hyoid bone, arytenoid cartilages, aryepiglottic folds, laryngeal vestibule, ventricular folds, ventricles of the larynx, trachea. The vocal cords cannot be differentiated.

not yet been completed, and this information will be included in a subsequent report.

All of the following structures may be easily interpreted from their shadows in the necks of older children and adults and many of them in infancy and early childhood:

1. The Pharynx. This is easily seen as an air containing passage, wide at the top where it is continuous with the oral cavity and nasopharynx and narrowing somewhat below as the vestibule of the larynx and pyriform sinuses are reached. It is variable in size in the young, as previously stated (Figs. 4 and 5).

2. The posterior border of the tongue curves from the oral cavity above, backward, downward and then slightly forward to the base of the epiglottis.

3. The uvula is often seen differentiated from the shadow of the tongue, curving downward and backward from the palatine arch.

4. The epiglottis is usually seen at all ages and always in adults under all normal conditions. When visible, the epiglottic vallecula is readily located.

5. The arytenoid cartilages are always visible to some extent, especially in young children (Figs. 6 and 7).

6. The superimposed aryepiglottic folds are usually visible as a faint shadow. It will be found by the casual observer that the arytenoids are very variable as to location in relation with the other soft tissue structures. All the reasons for this are not certain but their position depends to some extent upon the exact point in respiration at which the individual stops breathing in the case of the adult or older child. In the infant and young child, it may depend upon the time of the exposure in relation with each phase and upon the degree of relaxation of the soft tissues of this region.

7. The superimposed pyriform sinuses are found at the lower extremity of the pharynx, and below the level of the arytenoid cartilages (Fig. 6).

8. The thyroid cartilage is usually difficult to see except by special technique, and its location and exact limits must nearly always be approximated.

9. The vestibule of the larynx is located by its boundaries. Its base is at the upper border of the ventricular folds. The posterior limit is at the arytenoids. Its anterior limits are from the base of the epiglottis down to the ventricular folds.

10. The ventricular folds are usually visible if well superimposed (Figs. 6 and 7).

11. The vocal cords are as easily seen as the ventricular bands (Figs. 6 and 7).

12. The ventricles of the larynx, between the two latter shadows should be seen in the roentgenograms of all normal adults and very frequently in infancy and early childhood. According to Hay,[10] they are much more often visible in the female than in the male (Figs. 6 and 7). In this connection, we have recently made a very important observation. We have found that in the normal adult neck one should always see the laryngeal ventricles roentgenoscopically at some time by having the patient talk or count for a while. The next step in our study was to determine whether or not the ventricles would show on phonation of the vowel sound "E" used by laryngologists in the approximation of the vocal cords, and we found that this procedure was so satisfactory that it was always possible to obtain roentgenograms of the ventricles in normal cases. In a recent conversation with Dr. Hickey[12] we found that he had antedated us in this discovery, and moreover, he had found that the phonation of any of the five vowel sounds would show the ventricles clearly, especially that of "A," although we find it more difficult to obtain roentgenograms by the use of this sound. We believe that the inability to observe this space roentgenoscopically or roentgenographically under the conditions of this test is evidence of the presence of a growth or inflammatory condition. Conversely, if the ventricles are clearly seen, a growth or inflammatory process such as tuberculosis, syphilis, diphtheria or streptococcic infections can be excluded. Ab-

sence of the ventricles on the roentgenograms of young children is not proof of the presence of a pathological condition, however.

13. The cricoid cartilage may be identified by the fact that it is a complete cartilaginous ring and its anterior and posterior extremities are often visible because the rays have to pass through more cartilage at these locations. The cartilaginous tracheal rings are absent posteriorly.

14. The lower extremity of the larynx is easily determined approximately, as a rule, as a straight line representing the lower margins of the shadows of the vocal cords. Actually, it should be estimated at the lower border of the usually invisible cricoid cartilage. It is much more difficult to outline the lower extremity of the larynx in children than in adults.

Fig. 8. A case of streptococcic laryngitis with temporary stenosis of the larynx, in a boy aged four years. Referred by Dr. Tucker. Endoscopy showed extensive infiltration in the larynx extending from the ventricular bands to the cricoid level. Note the obliteration of the air passage in this region. The condition cannot be distinguished from acute diphtheria.

Fig. 9. Acute diphtheritic stenosis of the larynx in a young child with suspected retropharyngeal abscess. This was our first experience with such a case, and we diagnosed it abscess because of the increased retrotracheal space, but we should have noted the absence of retropharyngeal swelling and the haziness in outline in the laryngeal passage. Referred by Dr. Gittings.

15. The trachea is easily seen at all ages, and only its extreme upper limits need bother anyone. The rings may be seen in part in most adults and older children as irregularities in the anterior aspect. In some older adults the actual rings may be visible.

PATHOLOGICAL CONDITIONS INVOLVING THE UPPER RESPIRATORY TRACT

It is a significant fact that the great majority of upper respiratory or neck cases in infancy and early childhood are brought to us for examination because of obstructive symptoms arising in the air passages, or less often, dysphagia. In later life, hoarseness or dysphonia or aphonia and dysphagia are the prominent clinical phenomena, and much less frequently dyspnea, which is usually due to large growths.

Fig. 10. Postdiphtheritic stenosis of the upper trachea, in a boy aged seven years. There is a persistence of stenosis following tracheotomy and treatment, but the result was regarded as satisfactory. Referred by Dr. Tucker.

During infancy and early childhood there is nothing of particular interest in connection with the nonspecific inflammations. Of the specific inflammatory conditions, streptococcic infections, tuberculosis and diphtheria are worthy of mention.

Streptococcic Infections. Streptococcic infection of the larynx may cause obstructive breathing, and the lateral view of the neck is likely to show a decided degree of obliteration of the lumen of the larynx. The appearance is difficult to differentiate from that of the acutest age of diphtheria. We have examined only one case of this kind and the patient was a child aged four years (Fig. 8).

Laryngeal Diphtheria. The effects of diphtheritic infection of the larynx are encountered at two periods—the acute stage and later on as a condition of cicatricial stenosis. We have encountered one case of acute diphtheritic infection in a child aged thirteen months, with a history of acute onset of obstructive breathing after several days of cough. Retropharyngeal abscess was suspected, and at the time we diagnosed the case as one of this condition because of slight widening of the retropharyngeal space. We should have noted, however, that the retrolaryngeal space was not widened. There was also haziness in the laryngeal region and narrowing of the laryngeal lumen. At any rate, the case presented, roentgenoscopically and roentgenographically, the phenomena and appearances of high obstruction. This called for an immediate endoscopic examination, and Dr. Tucker found acute laryngeal diphtheria (Fig. 9).

We have recorded as diagnosed 5 cases of postdiphtheritic stenosis, representing the more recent cases, although 31 others are known to have been examined and passed over as negative before we learned its appearance. Most all of the 5 cases showed decided narrowing of the subglottic region of the trachea (Figs. 10 and 11), and one of them, interstitial emphysema of the soft

Fig. 11. Postdiphtheritic stenosis of the larynx and upper trachea, in a child, aged twenty months. Diphtheria one year before. Still under treatment. Referred by Dr. Tucker.

tissues of the neck. In acute diphtheria with membrane the most obstructed region is in the neighborhood of the vocal cords and immediately below because this is the narrowest part of the tract, whereas, as pointed out by Hay,[10] the cicatricial stenosis narrows the least rigid point of the neighborhood below the cricoid cartilage in the upper trachea, where the cartilaginous rings are not complete posteriorly.

Notwithstanding the ease with which such stenoses can be detected and located and their caliber estimated, there seems to be an almost total lack of knowledge of this means of diagnosis. There are certainly cases with obstructed breathing referred to roentgenologists without diagnoses in which postdiphtheritic stenosis is likely to be found, and the patient can be referred at once for endoscopy and subsequent treatment on the basis of the roentgenological findings. Lack of knowledge of this means of diagnosis by the roentgenologist is likely to cause delay.

In children, diphtheria is the frequent cause of tracheal stenosis. Scars of tracheotomy wounds constitute another frequent cause. Stenoses of the trachea are not infrequently congenital. Such a case was the first in which we ever made a diagnosis of a soft tissue lesion of the neck in connection with the upper respiratory tract, aside from the tracheal deviations due to thyroid enlargements. Trauma, such as fractures of the larynx and accidental or suicidal wounds of the trachea, belong to a later period in life than that with which we are dealing.

Tuberculous Conditions. We need not be concerned with tuberculous disease of the upper air passages in infancy and early childhood as it is a manifestation mainly of later life. Insofar as the neck is concerned our interest centers around the appearance of calcification in tuberculous adenitis. As a rule, roentgenologists have been inclined to view this appearance with passive interest rather than to regard it as of any particular significance. Now that we are justified in placing the stigma of tuberculosis upon calcifications in lymph nodes in practically all, or at least nearly all, instances on the basis of the investigations of Opie,[27,28] and others, the appearance really becomes of some diagnostic value, and may be a fairly reliable substitute for a biopsy. The shadows are usually multiple and irregularly mottled, and not rounded and homogeneous as found so frequently in the majority of tracheobronchial lymph nodes. In young children they do not have to be differentiated from thyroid calcifications and submaxillary salivary calculi as in adults, although this differentiation is easy by location as well as appearance.

Retropharyngeal and Retrotracheal Abscess. This condition may be encountered at any age, but is due to rather different causes at different periods of life. The roentgenological diagnosis is practically as easy as the detection of a fracture in a long bone, and yet there is very little to be found in the literature upon the subject. Certainly in many of the cases diagnosed clinically, the condition can be detected roentgenologically before the clinical diagnosis is made or often even thought of. It does not seem to be a condition in which the diagnosis is made at an early stage as a rule, at least in general practice. For example, in a recent communication, Greenwald and Messeloff[9] (1929) discuss 55 cases of retropharyngeal abscess in children and state that every one of these patients was brought to their attention with the condition undiagnosed. Incidentally, they fail to mention the employment of roentgenological means of diagnosis in a single instance.

Chevalier Jackson gives as the important etiological factors in children spinal caries and tonsillar infections in 90 per cent of the cases. There is a free communication from the tonsil to the retropharyngeal space through the loose tissues and lymphatics in this region in the young child. Infected and subsequently suppurating or caseating cervical lumph nodes and otitis are other

frequent causes. As other less common etiological factors have been mentioned rhinitis and sinusitis. In addition to the loose tissues and lymphatic distribution in the child, the connection of these lymph channels with several retropharyngeal lymph nodes is probably the most significant factor in the carrying of infection to this region from the various sources named and the subsequent suppuration. In the adult, the retropharyngeal tissues are thin and closely attached to the vertebrae and are not conducive to the spread of infection from these sources. While perforating foreign bodies in the esophagus, such as pins, safety pins, jackstones and collar buttons, are well recognized causes of abscess in children, the foreign body group are probably more potent factors in adults from the lodgment of fish bones and other sharp mistaken articles of food.

The diagnosis of retropharyngeal and retrotracheal or retroesophageal abscess depends upon a decided increase over the normal in the soft tissue space in front of the vertebral bodies. Naturally, one must first exclude a large nonopaque foreign body in the esophagus, as a bolus of meat or potato, as the cause of such an increase in the measurement, and in adults, a large growth in the pharynx, hypopharynx or esophagus. It should be borne in mind that esophageal foreign bodies encroach, for the most part, on the retrotracheal or retroesophageal and not the retropharyngeal space. As the esophagus is collapsed, we cannot differentiate between retrotracheal and retroesophageal abscess without a knowledge of the history of the case and an examination of the esophagus with an opaque medium. In the series of cases reported by Hay[10] the retropharyngeal space measured from one and one-half to ten times the normal for the age (Fig. 12).

A collection of gas or air is occasionally found in the swelling and is of considerable value in diagnosis. This may gain entrance through the infected wound of a foreign body, through spontaneous rupture or through a punctured wound for drainage. Such cases have been reported by Iglauer and Ransohoff,[14] and Tucker.[37] In one case, what would have been otherwise practically a nonopaque foreign body was clearly seen in the gas bubble, because of the contrasting surroundings

Fig. 12. Retropharyngeal abscess in an infant seven months old. Glandular or tonsillar origin. Swelling of neck one week duration. Referred by Dr. Tucker.

Our series so far comprises 21 cases, diagnosed as abscess, 13 being in children and 8 in adults, and none of them was due to spinal caries.

We have found it most essential to base a diagnosis of retropharyngeal abscess in young children upon lateral roentgenograms made during both phases of respiration. The retropharyngeal space is usually considerably wider on expiration than on inspiration when the pharynx is full of air, as previously mentioned, and the younger the child, the more noticeable is this difference. A lateral view on expiration alone may suggest a retropharyngeal abscess

because the retropharyngeal space is comparatively wide, whereas this space usually narrows considerably on inspiration, in addition to the anterior displacement of the anterior portion of the pharynx. This difference in the posterior space is due to the fact that the tissues are lax and easily movable in the very young. In order to diagnose abscess, the space must be too wide during both phases. As a matter of fact, we have made the error in the past of diagnosing or suspecting abscess before we realized this at a time when we made only one lateral view, and our interpretation was based on the expiratory phase. Reexamination of the child with an exposure during inspiration showed that there was no abscess (Figs. 4 and 5).

This respiratory pharyngeal phenomenon has often been utilized by us in determining from the roentgenograms whether or not we have made the exposures at the proper phases, especially when there are chest signs of high obstruction present, although it may not be an invariable test. The discovery of the great variations in the pharynx has been comparatively recent. Its importance was greatly lessened by the fact that it did not appear to be an invariable finding as our experience grew. Recent roentgenoscopic studies were instituted in an attempt to show just why the phenomena were not uniform. We then learned that they are accurately associated with the two phases only when the child is crying in a regular manner. Sobbing or "catchy" crying will cause the pharynx to open up at irregular intervals during what we might readily mistake for an expiratory phase. The phenomena are most marked during infancy, and the difference in pharyngeal size at the two phases gradually diminishes up to the age of three years, when it becomes scarcely noticeable.

Although it has not been our intention to make a study of the nasopharynx, we have been interested in some observations of Schüller[34] on conditions which cause encroachment upon the posterior portion of this cavity, and they might well be mentioned in connection with retropharyngeal abscess. He states that the postpharyngeal tissue shadow is about 1 cm. thick, but does not give the age at which this measurement is applicable. Adenoid tissue makes a marked tumor-like projection into the upper pharyngeal cavity. Aside from this, the conditions which cause encroachment upon the epipharyngeal cavity and cause more or less obstruction to nasal breathing are, for the most part, bony deformities of the base of the skull and the upper cervical vertebrae.

He divides these bony deformities into three groups, as follows: (1) All of those due to shortening of the base of the skull, and they may be congenital or acquired. An example of the congenital type is the deformity seen in chondrodystrophy. Examples of the acquired types in early childhood are the occipital sinking in rickets and the results of lying on the back too long in paralyzed and defective children. The curvature of the posterior fossa is accentuated or kyphotic. (2) Congenital or acquired deformities in the upper cervical vertebrae, as atlas assimilation, congenital luxation of the atlas and rachitic deformities. Traumatic dislocation of the craniovertebral joints is also included. (3) Deformities in craniostenosis.

Foreign Bodies. The subject of foreign bodies in the upper air passages and esophagus has been so thoroughly covered by other writers, notably Manges,[24] and is so generally understood, that further mention of it in connection with the neck would be unnecessary repetition. We take the liberty of presenting an abstract of the signs of nonopaque obstructing foreign bodies in the upper air passages as they have been so admirably worked out by Manges,[24] because these same phenomena can be produced by other obstructing factors, and reference must be made to them. The signs of an obstructing body lodging below the glottic chink may be summarized as follows:

Inspiration

Normal equal aeration of lungs.
Diameter of bony thorax approximately normal.
Heart shadow normal in size.
Diaphragm domes at normal levels for this phase.

These approximately normal appearances are possible because the usual foreign body does not obstruct during inspiration.

Expiration

Obstructive aeration or emphysema of both lungs.
Diameter of bony thorax the same or decreased.
Heart shadow *smaller* than on inspiration (the reverse of what is seen on normal respiration). It is somewhat rotated.
Both diaphragm domes lower than the levels seen on inspiration (the reverse of normal).

These phenomena are peculiar to foreign bodies in the trachea which obstruct during the *expiratory* phase, but they may be observed in connection with other causes of high obstruction on rare occasions. Enlarged thymus, diphtheria, tracheal stenosis, retropharyngeal abscess, tumor and recurrent laryngeal paralysis in children from enlarged thymus almost always obstruct during the *inspiratory* phase or just at the beginning of inspiration, and the phenomena are quite different as a rule from thsoe of foreign bodies. Both types of obstructive phenomena may be artificially produced, studied and recorded, as recently suggested by Crowden and Harris[5] (1929). They call attention to the fact that the *expiratory* phenomena may be produced by ultilizing the classical experiments of Valsalva (1740) of having the subject fully inspire, then close the glottis and try forcibly to expire without letting air escape. The heart shadow becomes smaller and the lung markings more prominent. The experiment of Johannes Müller (1838) was the reverse, that of having the subject close the glottis at expiration and then attempt to forcibly inspire. The phenomena would correspond to those of *inspiratory* obstruction. The shadows of the heart and vessels are larger and the trunk shadows more prominent than normal on this forced but obstructed *inspiration*. The phenomena of this latter experiment correspond to those usually associated with the obstructive conditions, namely, diphtheria, tracheal stenoses, retropharyngeal abscess, tumors, especially of the larynx, recurrent laryngeal paralysis and soft tissue collapse associated with enlarged thymus and even enlarged thymus itself. In thymic enlargement, however, the inspiratory obstructive phenomena are rarely in evidence from this condition alone. As the heart shadow is *larger than normal* during the inspiratory phase, the phenomena closely resemble those of expiratory obstruction, although they are different, and one may not be able to distinguish between the two types, except that the domes of the diaphragm, while the reverse of normal, are associated with a marked pulling in of the ribs, interspaces, xiphoid and supraclavicular regions.

The Thymus. One hesitates at this time to bring up for roentgenological discussion the time-worn subject of enlarged thymus, with the idea of being in the least way dogmatic. We believe, however, that from the roentgenological standpoint the surface of this subject has hardly been scratched, with apologies for such a commonplace expression. Contrary to the prevailing opinion, there seems to be very little positive or exact knowledge concerning this structure from either the roentgenological or other points of view. The laity is much stirred up about this structure, pediatrists are much alarmed about it, and a large part of our diagnostic and therapeutic practice is devoted to the administration of a moral diagnostic and therapeutic sedative which is all too frequently based largely on hearsay or personal opinion, often without proper foundation.

There are, however, certain definite and well-founded facts concerning the thymus which are not sufficiently well known generally and which, we believe, deserve due consideration. Beyond these, there is one school which is insistent that certain dangers arising from what is apparently obstructed breathing are mechanical in origin

and inherent in an abnormally large thymic gland or one which becomes abnormally large under certain conditions and actually obstructs the trachea, and even causes other remote phenomena as asthma and pyloric spasm with vomiting. We have been compelled to work along this line of reasoning, following the studies instituted by Lange[22] in 1911 and to govern our procedures accordingly. We shall certainly continue to do this until convinced that we are entirely wrong. To do otherwise would be to court disaster if this one school is the correct one, and no harm is being done if it is proved that we are following the wrong course. On this basis we have made a special study of the thymus with a view of determining under just what roentgenological conditions it may be regarded as a menace. Likewise, we have attempted to formulate our thymic technique in such a way as to detect other conditions which may present symptoms similar to those of enlarged thymus.

A vigorous controversy based upon more or less theoretical grounds has raged for the past hundred years regarding the exact cause of death in cases of supposed status lymphaticus or enlarged thymus. Death in connection with the thymus has been ascribed to a great variety of causes. The causes of death have recently been conveniently abstracted and summarized by Marine[25] (1928). One theory is that it is due to the pressure of an enlarged thymus on the trachea, blood vessels or nerve trunks (Kopp,[20] Jackson,[15, 16, 17] Noback).[26] Another theory ascribes death to a constitutional defect manifesting itself through an injurious raising of the vagus tone, together with a deficiency of the chromaffin system and weakness of the sympathetic system (Paltauf,[29] Wiesel[39]). A third theory regards death as a result of hypersusceptibility to physical and chemical agents (Kundrat,[21] Blake[2]). A fourth cause is anaphylaxis. (Symmers[36]). A fifth ascribes the fatal outcome to an abnormal thymic secretion of a general lymphotoxemia (Svehla,[35] Escherich[6]).

Our own views are based very strongly upon the statements of Jackson, and correspond closely with those of many pediatrists who see wisdom in being on the safe side of the thymic controversy. We believe, therefore, that the thymic menace is largely one of tracheal compression. Jackson,[15] in 1907, made the following statement: "It has been my privilege, with the aid of the bronchoscope, to demonstrate beyond all doubt on the living patient the purely mechanical nature of 'thymic asthma' in one instance. This, of course, does not prove that every case has this same pathological mechanism, but it does prove the occurrence of that which many.... have denied, namely, that a hypertrophic thymus can compress the trachea sufficiently to obliterate its lumen.... it would seem more accurate to call it thymic tracheostenosis." He further suggested: "Let thymic asthma be applied to cases supposed to be associated with neuropathic, convulsive, lymphatic, rachitic, hemic or other pathology, if desired, until their exact pathological mechanism shall have been demonstrated." In 1915, based upon further observations, Jackson[16] made the following statement: "Thymic death under anaesthesia attributed to 'status lymphaticus' and 'hyper-thymization of the blood' are nothing more or less than arrested respiration due to obstructive pressure of the engorged thymus. Artificial respiration is useless, as air cannot be drawn into the lungs, although it can be forced out. After death the engorgement factor is not evident." In a recent communication,[17] he states that "over 300 cases since that time have been observed bronchoscopically showing compression and the purely mechanical character of wheezing, dyspnoea and the impending asphyxia from thymic pressure." "The upper orifice of the thorax is a rigid ring and coughing, choking and hard breathing jam the large thymus into this ring and compress the trachea. After asphyxia the thymus shrinks because engorgement is depleted and at autopsy the thymus is no longer compressing the tra-

chea." In view of these statements of a careful observer of actual conditions in the living, we, who have the next best opportunity of observation during life, and under circumstances conducive to engorgement, cannot do otherwise than take the stand of thymic compression, or, to use the better term of Jackson, thymic tracheostenosis.

Further confirmation of these views is found in the anatomical studies of Noback.[26] He states that the gland is usually cervicothoracic in location and that the apex of the wedge-shaped structure passes through the upper thoracic outlet in 80 per cent of cases. Knowing as we do by roentgenological studies that the thymus is pushed upward during expiration, it is easy to see how the apex of the wedge jams up in this narrow, bony and rigid outlet and compresses other yielding structures in the same passageway. Noback believes that the broad type of gland described as typical of the newborn soon becomes molded after the establishment of respiration by the expanding lungs into a more elongated shape. A thymus that is not broad may become thick and press on structures behind it.

The technique previously described for the examination of the chests and necks of infants and young children was adopted because it seemed best fitted for the detection of two important conditions—thymic enlargement and foreign bodies—and at the same time, was perfectly satisfactory for all other purposes at this age. The neck is very easily included with the chest in this technique. The examination as ordinarily carried out by most individuals *does not give the correct data* in regard to thymic encroachment. All that it does is to show size, and relative size varies with respiratory phase and position. As before stated, we are now convinced that the examination to be thorough must be made in both erect and horizontal positions, and as advised by Remer and Belden.[33] Moreover, Jackson[15] states that the dyspnea in thymic tracheostenosis is worse in the erect posture. Most of us think that raising the child to the sitting posture relieves obstruction of a thymus. What we probably do is extend the head and straighten the trachea. In the erect posture, one must be careful to see that the child does not slouch down, because if this happens, the large liver of the young child pushes up the domes of the diaphragm and causes buckling of the trachea, or increases that which is already present.

There are two reasons for examining thymic suspects in the posteroanterior direction during both phases of respiration. In the first place, there is a great difference in the width of the shadow of the gland, it being much wider in the expiratory phase. If any comparative measurements are to be made, this should be based upon the appearance at both phases. As a matter of fact, however, we pay but little or no attention to this view in diagnosis as far as the thymus is concerned, and usually only when the shadow is thick or dense, sug-

Fig. 13. Sagittal view of a thymic suspect, aged three weeks, expiratory phase. Note the marked deviation of the trachea to the right. It was found almost in the midline during the inspiratory phase, when the thymic shadow was narrower. Referred by Dr. Fife.

gestive of lobation, or causes a lateral deviation of the trachea (Fig. 13). Baetjer,[1] many years ago, was one of the first objectors to this view for diagnostic purposes. The thymus usually does not obstruct because it is wide but because it is thick. This seems to be one of the most difficult ideas to impress upon the minds of so many roentgenologists. Jackson[17] has stated that lateral compression of the trachea occurs in only about 25 per cent of the cases. This would be difficult to detect, and, as previously stated, we judge this possibility only by the shadow of a thick, lobulated gland (Figs. 14 to 17), or the lateral deviation of the trachea (Fig. 13).

Secondly, the thymus may not be responsible for the obstructive phenomena, and the two phases are essential for the detection of other causes of obstruction which may be suggested by this complete examination. The thymus *by itself rarely exhibits any very definite roentgenological obstructive phenomena.* If it did, the child would be in a very dangerous condition all the time. If definite obstructive phenomena are present, there is usually some additional and associated cause, as collapse of the soft tissues higher up or recurrent paralysis, to be referred to later. In infancy it is naturally a preponderant structure, and, with the exception of cases in which there is a strong history of foreign body, retropharyngeal abscess, diphtheria, whooping cough or a few other conditions, it is almost always suspected as the cause of obstructed breathing, or what is taken for obstruction, until it can be excluded.

The question of cyanosis arising as a result of thymic pressure upon large venous trunks is worthy of consideration. In cases of enlargement of the left lobe, the left pulmonary vessels might be pressed upon and cause a general cyanosis that could be mistaken for the result of a congenital heart condition. Noback[26] calls attention to the close relation between the thymus and important blood vessels. On the right side the gland is closely applied to the superior vena cava, and the left innominate vein, and occasionally the superior vena cava is imbedded in the posterior aspect of the gland. Noback states that in several instances he noted evidences of compression of the innominate vessels as they passed through the upper thoracic outlet, and in one specimen the artery was so greatly compressed against the trachea that it produced a definite furrow across the air passage and reduced its lumen. One might think it possible for cerebral disturbances to result from interference with the venous return from the neck.

The lateral view is essential in thymic examinations because thickness of the gland in relation with the trachea is usually the key to the situation. The essential roentgenological features of pathological enlargement of the thymus are *kinking or compression of the upper intrathoracic trachea.* Both phases of respiration are necessary to prove either of these appearances because we must compare the tracheal caliber at the two periods. During the expiratory phase and just as inspiration begins, there is a normal collapse of the trachea from behind, due to the absence of the cartilaginous ring structure on this aspect. Jackson[17] states that the tracheal collapse in infants is as easy as that of the bulb of a medicine dropper, and that the normal change in lumen at the beginning of inspiration is about 50 per cent, and involves the posterior or purely membranous portion. By bronchoscopic observation the lumen is seen to become crescentic instead of rounded, with the hollow of the crescent posterior. Because of the presence of air in the horns of the crescentic lumen, the apparent collapse, as seen on the roentgenogram, is not nearly as great as the actual amount. It will be noted, however, that the posterior part of the intrathoracic trachea is blurred and not clean cut as compared to the anterior aspect during the period of collapse.

Our signs of tracheal encroachment or potential stenosis from enlarged thymus in

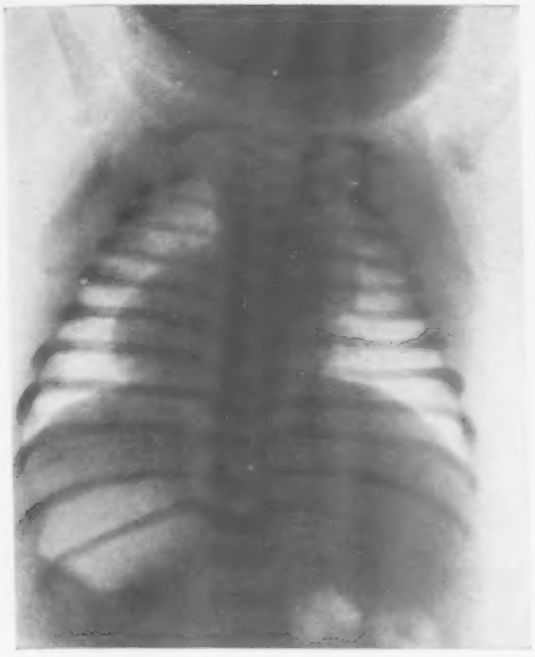

Fig. 14. Posteroanterior view, inspiratory phase. There is nothing unusual in the width of the thymic shadow, and we would pay no attention to this view except that the shadow is dense, denoting thickness, and decidedly suggestive of lobulation.

Fig. 15. Posteroanterior view, expiratory phase. The shadow of the gland is wider than usual, and one would expect that it is jammed up more or less into the thoracic outlet.

Fig. 16. Lateral view, inspiratory phase. There is a slight buckling of the upper intrathoracic trachea with the head in the proper midposition.

Fig. 17. Lateral view, expiratory phase. There is more collapse of the upper intrathoracic trachea than there should be at this phase. Referred by Dr. Fife.

Figs. 14, 15, 16 and 17. Views of a child aged seven weeks, showing the true roentgenological features of enlarged thymus with at least potential obstruction. Made in the horizontal position.

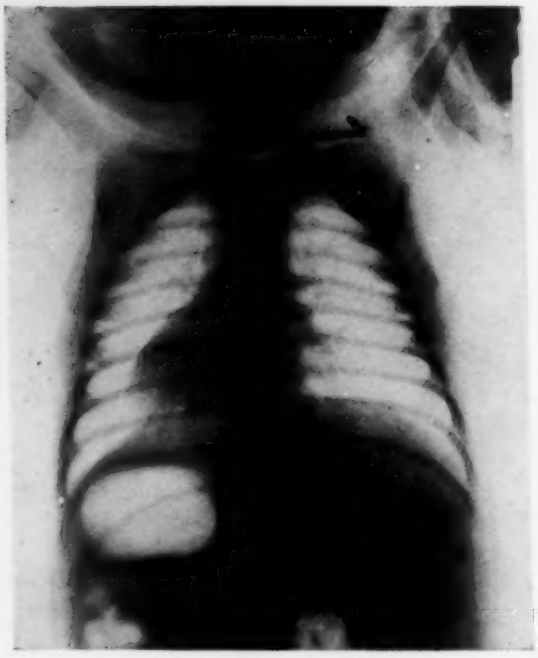

FIG. 18. Posteroanterior view, inspiratory phase. There is no abnormal widening of the thymic shadow, although it was much wider in the roentgenogram made in the horizontal position.

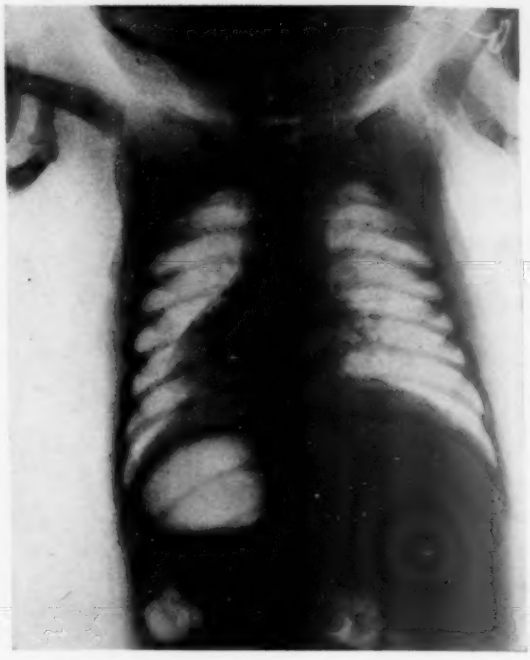

FIG. 19. Posteroanterior view, expiratory phase. The thymic shadow is slightly wider, but not abnormal. It is very much narrower than in the roentgenogram made in the horizontal position.

FIG. 20. Lateral view, inspiratory phase. There is no buckling or narrowing of the upper intrathoracic trachea.

FIG. 21. Lateral view, expiratory phase. There is no unusual collapse and no buckling of the upper intrathoracic trachea.

FIGS. 18, 19, 20 and 21. Negative thymus in a normal child aged one week. Erect posture technique. Note the better lung fields and less jamming of the mediastinal structures upward.

the lateral view are the following appearances:

1. Narrowing of the air space at the thoracic inlet on inspiration.
2. Too great a collapse on expiration.
3. Buckling of the trachea at either phase as it passes over the top of a large gland. This appearance must be based upon a rigidly enforced technique, especially in regard to the position of the head (Figs. 14 to 21).

To these should be added, of course, the lateral deviation of the trachea in the sagittal view. Any one or all of these signs are sufficient for diagnosis. Examinations as they usually seem to be made do not show these exact evidences of pathological enlargement. The lateral views during the two phases of respiration are also essential in the differential diagnosis of enlarged thymus and some of the other causes of high respiratory obstruction.

High respiratory obstruction may be due to numerous conditions in addition to enlarged thymus, and one should not be misled when examining an infant or young child because of the relative preponderance of this gland. Be sure that the examination includes every one of the possibilities that can be discovered before concluding that the clinical phenomena are of thymic origin. Some of the other conditions, it is true, cannot be found roentgenologically, and if the thymic size and tracheal relations do not explain the symptoms, or if they persist after what seems to be adequate treatment, further search by clinical or bronchoscopic means should be advised.

One should always have in mind the following conditions when examining an infant or young child with apparently obstructed breathing: Opaque and especially nonopaque foreign bodies, retropharyngeal abscess, tracheal or laryngeal stenosis, recurrent laryngeal paralysis, relaxed upper respiratory soft tissues, especially in rachitic children, asthma, whooping cough, meningitis and congenital heart conditions. Foreign bodies need not be discussed, as we find that the work of Manges[24] covers this subject completely. Retropharyngeal and retrotracheal abscesses have been referred to already in detail. The tracheal and laryngeal stenoses include those due to diphtheria, streptococcic infection, and the edematous tracheobronchitis from influenza, stearate of zinc and other irritants (Jackson[15]) and congenital narrowing.

Asthmatic cases are likely to be most confusing to the roentgenologist because, during attacks, the phenomena at the two phases of respiration may be quite similar to or the same as those of high obstruction. Asthma may be blamed on the thymus whether there is any connection or not. Whooping cough produces a mild tracheobronchitis and spasm of the glottis, which may be misleading at times.

It may seem strange that meningitis should be confused with thymic enlargement, but we have examined one case in which such confusion occurred. A child seventeen days old was admitted to the Hospital as an emergency case because of sudden onset of marked cyanosis, catchy respiration and occasional twitching of the extremities followed by generalized convulsions. Enlarged thymus was supected. Roentgenological examination showed no thymic enlargement and the lungs were negative. Roentgenoscopically, there was fixation of the domes of the diaphragm at irregular intervals, but they usually moved symmetrically and did not seem to be flattened. The mediastinal structures did not deviate with either respiratory phase. The child died shortly after examination and admission. Post-mortem cisternal puncture showed acute streptococcic meningtitis. If this child had been treated on the basis of the clinical diagnosis alone we or our treatment might have been blamed for the death.

Recurrent laryngeal paralysis is not an infrequent complication of enlarged thymus and is a most elusive condition because it cannot be detected by roentgenological

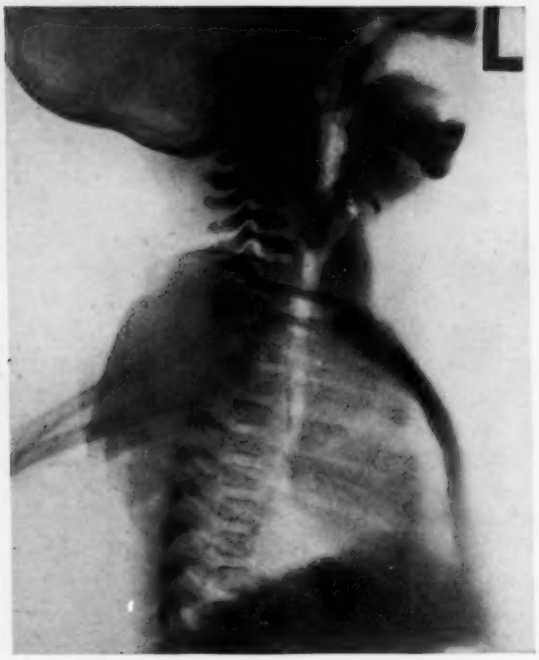

Fig. 22.

Fig. 23.

Figs. 22 and 23. Lateral views of both respiratory phases of a case of enlarged thymus complicated by recurrent laryngeal paralysis, in a child aged four months. By roentgenoscopy in the sagittal direction there was no shifting of the mediastinal structures. In the sagittal roentgenograms the heart shadow was somewhat smaller on expiration, which was suggestive of high obstruction, but there was about a normal amount of lung emptying. Referred by Dr. Jackson. Fig. 22. Expiratory phase. The trachea is fairly well open throughout. Fig. 23. Inspiratory phase. The thymus appears thick and there is a moderate encroachment on the trachea, which is the reverse of what is usually found in thymic enlargement. The thymus did not seem to explain all of the phenomena, and endoscopy was necessary. By direct examination, Dr. Jackson found a left recurrent laryngeal paralysis.

examination. The roentgenologist should have it in mind, however. We have encountered 3 cases. If the clinical signs suggest high obstruction and the roentgenological evidence is more of less corroborative, on the one hand, and persist following what has apparently been an adequate amount of treatment, on the other, an endoscopic examination should be advised. At the examination before treatment, the thymus will, of course, be found enlarged, but this will not explain all of the roentgenological findings (Figs. 22 and 23).

Recurrent paralysis is, of course, due to the thymic pressure. Ordinarily it persists after the gland has been reduced by treatment to a size which appears to be safe against pressure. The persistence of symptoms is then not due to thymic pressure and further treatment may not avail. According to Jackson,[17] recurrent paralysis is more serious in children than in adults because of the loose structures of the laryngeal and pharyngeal tissues in the former which aid in the obstruction. If it persists for three or four months it is likely to be permanent. Bilateral recurrent paralysis is rapidly fatal unless immediate tracheotomy is performed. Jackson[17] has had to perform tracheotomy three times for bilateral paralysis but never for unilateral involvement. No cases have had to be operated on since the advent of roentgen therapy. Bilateral recurrent paralysis may explain some of the thymic deaths, and we are inclined to believe that it is very

likely the most frequent participating factor.

The recurrent laryngeal nerves are practically the only ones likely to receive dangerous pressure from the enlarged gland as they pass through the upper thoracic inlet. Boyd[3] calls attention to the frequent possibility of this complication, from anatomical studies, and to the clinical observation of the frequency of inspiratory stridor, hoarseness or a crowing cry suggestive of spasm of the vocal cords from irritation of the recurrnt laryngeal nerves. In our own cases, either the right or the left nerve has been involved, with paralysis, showing that either or both can be dangerously pressed upon. If a goiter in the neck, free from bony confines, can cause recurrent paralysis, it is easy to understand how the apex of the thymic wedge pressing on all of the structures passing through the bony ring of the superior thoracic inlet can still more readily produce dysfunction of these nerves.

Attention has been called to the part that the loose tissues of the upper respiratory tract of the infant and young child play in retropharyngeal abscess, recurrent paralysis and in the variable retropharyngeal shadow at different periods of respiration. This characteristic is found in connection with the pharyngeal tissues, the vocal and ventricular folds and the aryepiglottic folds. While it does not in itself cause any definite obstacle to breathing, still, under the stress of obstruction anywhere in the upper respiratory tract, it tends to collapse and undoubtedly does become an intensifying factor. Jackson[17] states that the collapse of loose tissues may aid in the obstruction in any case in which the child has to pull hard on inspiration. Otherwise the loose tissues do no harm except sometimes to cause a noise which may be mistaken for obstructive breathing. We have recognized this sound in suspected enlarged thymus cases in which we failed to find the signs of obstructive enlargement. According to Jackson, marked collapse is seen most often in association with rickets. We would expect, therefore, that rachitic cases would show the most obstructive signs with the least thymic compression, and they would have, therefore, the added danger of the collapse of the soft tissues.

In the necks of many infants we have noticed that the shadow of the tips of the arytenoid cartilages touched the lower aspect of the margin of the epiglottis, especially at the beginning of inspiration. This is a position assumed during the swallowing act, and the appearance was, when first detected by us, regarded as a possible evidence of soft tissue collapse, but it was later noted in many clinically normal infants. We have regarded it as abnormal and as an evidence of collapse only when there is an associated lack of air in the laryngeal vestibule. This combination has been noticed recently in some cases of enlarged thymus, but we are not yet prepared to state emphatically that it is always abnormal.

SUMMARY

1. Roentgenological studies of the chests of infants and young children should always include the neck, in order to detect possible obstructive lesions in the upper respiratory tract that may explain, in part or entirely, suspected intrathoracic conditions. In older children and adults, inclusion of the upper tract is necessary in certain groups of cases.

2. As the subject of the examination of the neck is a broad one, the findings in only the very young are discussed at this time. The esophagus in not included.

3. The literature on this subject is very meager.

4. The basis for the detection of upper respiratory conditions is complex. The soft tissues of the neck surround a more or less rigid air containing passage,—the pharynx, larynx and trachea, which can be visibly encroached upon: a collapsed potential space,—the esophagus, can be filled by

opaque media; the dense vertebrae occupy a fixed relative position for estimating displacements and making measurements; clear views are easily obtainable of the intrathoracic trachea and its relations; and certain phenomena observable in the chest may be associated with or due to obstructions in the upper air passages.

5. A uniform and comprehensive technique is essential and is described.

6. A study of the normal is necessary as a basis for the diagnosis of pathological conditions.

7. The following structures are easily seen in roentgenograms of the neck at ages when their detection is important: The posterior border of the tongue, uvula, pharyngeal cavity and its walls, epiglottis, aryepiglottic folds, pyriform sinuses, laryngeal vestibule, ventricular and vocal folds, laryngeal ventricles and the lower limits of the laryngeal cavity.

8. The following pathological conditions amenable to roentgenological diagnosis are discussed in detail: Streptococcic laryngitis, acute diphtheria, postdiphteritic and other forms of stenosis, tuberculous adenitis with calcifications, retropharyngeal and retrotracheal abscess, encroachments on the nasopharynx, foreign bodies and the thymus.

9. The stand is taken that thymic death is due largely to obstructive tracheostenosis, but is usually assisted by other factors aiding in upper respiratory obstruction. It is realized that much of the diagnosis of enlarged thymus is based upon inadequate examinations. A comprehensive technique is described.

10. The only definite or reliable signs of an enlarged or potentially obstructive thymus are narrowing of the trachea at the upper thoracic outlet on inspiration, too great a collapse on expiration or buckling at either phase, as shown by the lateral view, or lateral deviation of the trachea shown in the sagittal view.

11. The preponderant thymus of infancy and early childhood may be blamed for obstructive phenomena for which it is not responsible or which aid in the obstruction or cause a persistence of the symptoms after subsidence of the gland by treatment. In this connection, the examiner must have in mind the following: Foreign bodies, retropharyngeal abscess, tracheal and laryngeal stenoses, recurrent laryngeal paralysis from the thymus, the relaxed soft tissues of the pharynx and larynx in the young, asthma, whooping cough, meningitis and congenital heart conditions.

12. Many new aspects of the condition have become apparent in our studies of the thymus, and we realize that it is a research problem with many intricacies which need further investigation. This presentation is, therefore, of the nature of a preliminary report.

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DISCUSSION

Dr. Chevalier Jackson, Philadelphia. The clinical records of the bronchoscopic clinics afford an abundance of clinical evidence to support every statement made by Drs. Pancoast and Pendergrass. One statement, particularly, is corroborated by hundreds of cases, namely, "This structure has been blamed for much for which it is not responsible." Many children coming in with a diagnosis of thymic hypertrophy have been found to have some other condition, such as foreign body; adenopathic compression; stenosis; tuberculosis; papillomata of the larynx; recurrent laryngeal paralysis; congenital laryngeal stridor; congenital stenosis, in some cases of the larynx, in other cases of the trachea, in still others of the bronchi. In some of these cases the thymus was hypertrophied but was not the cause of the

symptoms. In a second group the thymus had been enlarged but had been reduced by radiation without improving the symptoms of which it was not the cause. In a third group of cases the thymus was well within normal limits and had never been hypertrophied. All three groups of cases were illustrations of blaming the thymus for things for which it was not responsible. Nevertheless, the thymus, when hypertrophied or congested, does produce stridor, dyspnea, and if not treated skilfully, death by asphyxia; and I am sorry to say these latter cases are more frequent than is realized, though they are not so common as they were before the discovery of the efficiency of roentgen treatment of thymic hypertrophy. During asphyxia the engorged thymus is jammed up into the bony ring of the upper thoracic aperture. After death the somewhat shrunken thymus retreats downward and the compression may not be evident at autopsy, though I have seen and published cases in which it was evidenced at autopsy by the dinge in the trachea.

Of all the theories on the mechanism of thymic death, I can say only that they are theories. It is a fact, a clinical fact, that the hypertrophied thymus does compress the trachea, sometimes to the extent of complete occlusion. Hundreds of times, since the initial observation quoted in the paper, I have seen it with my own eye at the bronchoscope; often I have pushed the bronchoscope through the thymic compression stenosis to keep the child from asphyxiating until I could do a tracheotomy.

The clinical signs which are absolutely diagnostic of obstruction in the larynx and upper trachea of all the types mentioned by Drs. Pancoast and Pendergrass are these: indrawing at the suprasternal notch, around the clavicles, in the intercostal spaces, and in the epigastrium. The latter produce the so-called "funnel-breast," but the milder degrees of obstruction may produce only the indrawing at the suprasternal notch. It is absolutely diagnostic of high obstruction and it occurs in absolutely no other form of dyspnea.

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A CLINICAL AND ROENTGENOLOGIC CONSIDERATION OF PULMONARY INFARCTION*

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ETIOLOGY AND COURSE

HEMORRHAGIC infarction[6] of the lung is usually the result of embolic occlusion of a branch of the pulmonary artery, although it may follow thrombosis. Peripheral venous thrombotic processes and intracardiac mural thrombosis are common sources of emboli. Passive congestion of the lung, from whatever cause, greatly favors infarction. It is especially common in cardiac disease because of the presence of passive congestion, the frequent occurrence of intracardiac thrombosis and vegetation of valves, and the enfeebled return flow of venous blood which predisposes to peripheral venous thrombosis. Signs of pulmonary infarction may precede clinical evidence of thrombosis by several days or this evidence may never be apparent. Femoral thrombosis or thrombophlebitis and uterine venous thrombosis are common sources of emboli after child-birth. After operation, thrombotic processes in the prostatic and pelvic plexuses and femoral veins are potent sources of emboli.

Pulmonary infarcts are rarely single; they usually occur in groups of from ten to twenty. They are most common in the lower lobes, especially along the sharp margins of the lung and the borders of the interlobar clefts, and are wedge-shaped, with the apex toward the hilus and the base toward the pleura. Fibrinous pleuritis occurs early over the infarcted area. The wedge-shaped infarct is blackish-red, lacks crepitation, and at its apex a bronchus and a branch of the pulmonary artery occluded by an embolus may be seen.

It is well known that occlusion of a branch of the pulmonary artery is not always followed by infarction. The explanation for this may not be apparent, although the general opinion is that passive congestion of the lung is usually the determining factor in bringing about hemorrhagic infarction. As a rule, collateral circulation in a normal lung is sufficient to prevent its occurrence even when large branches are occluded. It is difficult to produce infarction experimentally in healthy animals with artificial pulmonary emboli. Virchow produced infarction with infected emboli. Experiments by Karsner and others, in which emboli were placed in the pulmonary arteries of animals with normal and with congested lungs showed that the circulatory changes in the first twenty-four hours were identical. After this, however, speedy resolution occurred in the normal lung, whereas in the congested lung infarction took place. This explains why, in certain cases, all the symptoms of the lodgment of an embolus may occur without the development of evidence of infarction that can be elicited by physical or roentgenologic examination, and the patient, in a short time, may be free from all pulmonary symptoms.

If the adjacent pulmonary tissue is healthy and the infarct is small, after a period of a few weeks no trace of its occurrence will be apparent, aside from slight

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

pigmentation. Larger infarcts may be followed by necrosis, granulation and deep linear cicatrices. Of considerable importance is the frequent occurrence of residual pleural thickening and adhesions. General pleuritis may spread from the base of the infarct, and a serofibrinous, hemorrhagic, or purulent exudate may occupy the pleural space, compressing the lung. The infarct may break down and result in perforation of the pleura. The communication of pulmonary infarcts with the bronchi permits the entrance of pyogenic and putrefactive bacteria; this often results in abscess and gangrene. Occasionally sequestration of an infarct occurs secondary to peripheral suppuration or gangrene.[9]

Calcification[6] rarely occurs in pulmonary infarction. It has been observed in osteoporosis and other disturbances of calcium metabolism that as a rule infected emboli, even if they completely occlude an artery, result in so much inflammatory change that the mechanical sequences of infarction are overshadowed from the beginning and suppuration occurs. Bacterial emboli are sometimes seen in capillaries in cases of pyemia without demonstrable structural change in the surrounding lung.

Certain circulatory disturbances which favor peripheral venous thrombosis and pulmonary infarction take place in surgical cases and deserve mention. First of all, the so-called respiratory pump[12] is interfered with when the abdominal cavity is opened, for the abdominal muscles are of considerable significance in the physiology of respiration, and they in turn normally aid in the return of venous blood to the heart. Other factors, such as general anesthesia, limitation of excursion of the thorax by bandaging, the patient's inability to ventilate the lungs because of pain in the wound,[8] recumbent posture, and enforced quiet, greatly favor pulmonary congestion and peripheral venous thrombosis. Trauma to tissues during operation favors thrombosis in the smaller veins.

SYMPTOMS AND PHYSICAL SIGNS

The clinical picture of fatal pulmonary embolism when once seen is not easily forgotten. The patient may cry out at the time of the lodgment of the embolus and grasp the precordium with an expression of great anguish, or he may gasp for breath, and become suddenly deadly pale and pulseless.[15] Death usually ensues immediately, although the fatal outcome may be delayed several minutes or hours. The outcome is determined by the size of the vessel which the embolus enters and according to whether the vessel is partially or completely occluded. The patient may survive one or more emboli and succumb to succeeding ones. The associated condition of the other organs, especially the heart, definitely influences the outcome. Lemon and Willius found that myocardial injury was present in 42 per cent of cases of fatal pulmonary emboli occurring at The Mayo Clinic.

In nonfatal pulmonary embolism there is usually an abrupt onset of dyspnea and severe pain in the chest. Early there are fewer physical signs than the degree of dyspnea would suggest. Fever is often absent; when present, it is not high, except in the advent of infection. Leucocytosis (12,000 to 20,000 cells for each cubic millimeter) is usually found. Pain, usually of the pleuritic type, is commonly present from the onset, although it may be delayed or absent. Hemoptysis is of frequent occurrence and is exceedingly helpful in establishing the diagnosis. Bloody sputum may appear in a few hours or may be delayed for twenty-four hours or longer. Extensive infarction may occur without hemoptysis or the production of sputum of any type.[3] Often the blood is considerable in quantity and may be dark and clotted, although not infrequently only streaks of blood are seen.[14,15] One should always be suspicious of pulmonary infarction in any case in which there is cardiac decompensation and hemoptysis. Respiration is

usually shallow, rapid and painful. The patient is often found sitting up in bed, which is not common in pneumonia. Cyanosis is usually present, at least at the start. The heart sounds are often weak, in rapid succession and accompanied by murmurs. The pulse is rapid, small, and feeble, and at times irregular. The mind is usually clear but in the fatal forms of embolism, coma and convulsions may precede death. In weakened patients, particularly in case of cardiac decompensation, rapid, fatal cardiac failure often follows pulmonary infarction.[3] Hamman reported infarction shortly after an attack of angina pectoris. He called attention to a characteristic pulse and temperature curve, and pointed out that the pulse rate first rises rapidly, that later it falls, and that the temperature rises as the pulse rate falls. He also noted that pulmonary embolism is common in endocarditis from *Streptococcus viridans* but that even when the emboli contained bacteria, pulmonary abscess did not result. Diseases of the blood which predispose to thrombosis, polycythemia particularly, and chlorosis, predispose to embolic phenomena of the lung. The practically constant accompaniment of pulmonary infarction by pleuritis should be emphasized.[17] Pleuritis is responsible for the early pain and pleural friction rub. Later, fluid in large or small amounts is usually found in the pleural space. A great many authorities have expressed the belief that a large percentage of cases of postoperative pleurisy are secondary to infarction. Miller, in 1902, called attention to this, and reported 8 cases, with several from the literature, of postoperative pleuritis which developed on a basis of infarction. Many authors, including Hamman, feel that postoperative pneumonia is usually of embolic origin. The occurrence of pulmonary infarction following radical mastoidectomy, especially when the lateral sinus has been opened or exposed, has been noted and reported by several observers.[11,21]

For several hours after nonfatal pulmonary embolism has occurred, there are often no abnormal physical signs[4] in the thorax. The excessive dyspnea, usual cyanosis, marked acceleration of the pulse rate and the absence of local manifestations during the first few hours suggest the lodgment of an embolus in a pulmonary artery. The explanation for this phenomenon is readily seen. It takes some time for secondary changes to occur in the lung and pleura following arterial occlusion, and in the meantime the bronchi and alveoli are air-containing. It is also common for embolism to occur without infarction.[5,6] It has been shown experimentally and pathologically that in twenty-four to thirty-six hours adequate compensatory circulation is established in many cases in which the lung was normal previously. In those cases abnormal physical or roentgenographic data may be lacking entirely. A pleuritic friction rub is one of the earliest, most common and most reliable physical signs. This is usually heard at the base on the affected side. Osler stated that 50 per cent of the infarctions occur in the base of the right lung. When pleuritis has developed, as indicated by the friction rub, there is limitation of respiratory excursion on the affected side. Vocal fremitus may be decreased, due to pleuritis, often with effusion, and may be increased when consolidation takes place in a large infarct. In certain cases impairment of resonance develops. The area of impaired resonance does not advance as in pneumonia[14] unless there is a complicating pleural effusion, or unless fresh infarctions develop. The area of dullness, if these complications do not occur, disappears in two or three days.[14] Large infarcts may give rise to flatness on percussion. Tympany may be noted in cases in which necrosis and abscess formation take place. Preëxistent râles from passive congestion in cardiac disease are common. Fine crackling râles may be present in the infarcted region. Breath sounds are usually diminished or absent but return later when the effused blood is absorbed and the râles become coarser over the region involved.

CLINICAL DIAGNOSIS

The clinical diagnosis of pulmonary infarction in the typical case with acute dyspnea, pleuritic pain and friction rub, rapid pulse and circulatory embarrassment, gross expectoration of pure blood, especially if it is dark and clotted, is fairly easy. The diagnosis also is obvious when this occurs after the eighth, and up to the twenty-first day after operation, especially an abdominal operation, when the patient has been having normal convalescence. Wharton and Pierson mentioned a premonitory slight rise in temperature preceding this postoperative accident. It is not uncommon, however, for patients to come to necropsy with infarcts not previously recognized.[17] These cases of unrecognized infarct are usually complicated, or for some unaccountable reason fail to present characteristic symptoms and signs. Pulmonary infarction is often not recognized in patients who are very ill or in extremis for periods of several days. The later complications of infarction, such as abscess formation, empyema, large pleural effusions and associated pneumonia, often cloud the picture so that in the absence of a clear history of the onset, it is impossible to be certain that infarction was the primary pathologic process. It is also true that these complications may come on so quickly and so overshadow the usual symptoms that diagnosis is difficult. Infarction during the acute stage must be distinguished from pneumonia, particularly if the infarcts develop soon after operation and are multiple. This is especially true when the emboli are infected or if there are other associated septic conditions. Coronary occlusion may closely simulate pulmonary infarction; in fact, the latter may occur as a complication of it. Likewise angina pectoris may offer difficulties in differentiation. Pulmonary tuberculosis and neoplasms, aortic aneurysm with rupture, or massive atelectasis, may at times give rise to clinical pictures which are confused with those of pulmonary infarction. The ordinary forms of dry pleurisy or pleurisy with effusion and empyema are readily recognized as such; the problem is to exclude embolic processes as the basis of these conditions, which admittedly may be impossible.

ROENTGENOGRAPHIC DIAGNOSIS

The roentgen ray has proved to be a most valuable adjunct in demonstrating the pathologic changes which take place in the lung and pleura in pulmonary infarcts and their complications. Its use has been limited chiefly to the last decade and the development of efficient portable apparatus has been the contributing factor toward making the use of this valuable adjunct possible when it is most needed. Even

FIG. 1. Pulmonary infarction complicating cardiac disease with decompensation. Five days previously the roentgenologic examination did not reveal unusual shadows in the pulmonary fields. A few hours previously there was a sudden increase in dyspnea, and development of a severe pain in the right side of the thorax followed shortly by hemoptysis. The shadow appearing in the region of the upper lobe of the right lung is a perfect picture of infarction. There is also some increase in density in the lower lobe of the right lung.

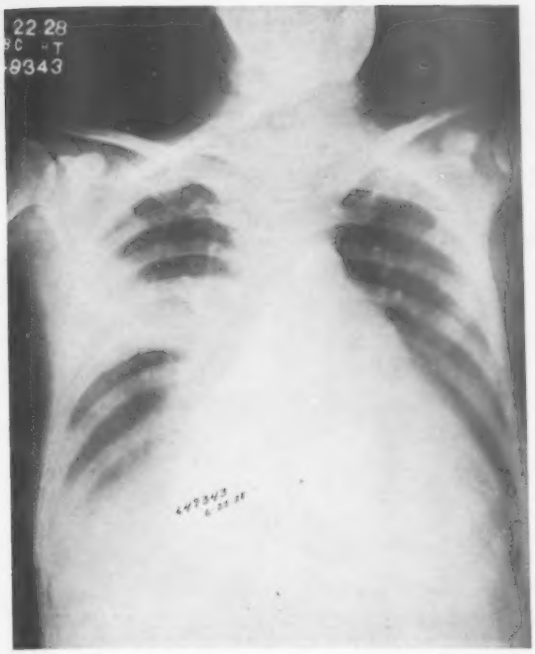

Fig. 2. Same case as that shown in Figure 1, five days later. Marked increase in the density of the upper lobe of the right lung, the result, at least in part, of the interlobar pleuritis accompanying the infarction, possibly with some effusion. There is marked increase in the density in the lower lobe of the right lung due to thickened pleura.

very sick patients may now be examined, for often it is easier and safer for the patient to undergo roentgenographic examination of the thorax than to undergo the exertion of extended general examination.

When typical, an infarct appears as a large triangular shadow, with its base toward the axillary line, and it may occupy a large part of a lobe (Figs. 1 and 2). There is frequently so much surrounding inflammation that an infarct may not be distinguishable from a pneumonic process (Fig. 3). Wessler and Jaches stated that not every extensive shadow in the lung occurring in cardiac disease should be considered an infarct because varieties of pneumonia do occur which are atypical clinically and which may, like infarcts, be terminal. Unfortunately the roentgen ray does not reveal the true nature of the lesions. Rieder and Rosenthal pointed out that hemorrhagic infarcts occur frequently in lungs with passive congestion, and for this reason fail to cast clearly outlined shadows. The passively congested lung is of almost the same density as the infarcted region, hence differentiation of tissue becomes extremely difficult. They stated that infarcts manifest themselves usually in the lowest part of one or the other lung, together with an associated pleural effusion. They described two chief types of shadows: a sharply defined triangular-shaped shadow with centrally directed apex, and a round or egg-shaped shadow. In the latter case the base lay anterior or posterior, with the apex directed sagittally. These occur on the borders of the lobes and more often on the right side. They must be distinguished from early pneumonia and thickened pleura and, when the shadow is round, from tumor, abscess, echinococcus cyst, syphilis and interlobar

Fig. 3. Same case as that shown in Figures 1 and 2, twenty-six days after date of Figure 2. Multiple embolic episodes have taken place. A dense shadow occupies the region of the right lower lobe and in the lower lobe of the left lung is a suspicious shadow.

effusion. If an infarct goes on to abscess formation it is more easily demonstrated by the roentgen ray.

Assmann stated that he has demonstrated few infarcts with the roentgen ray. Until the more general use of the portable roentgen-ray apparatus, roentgenograms were made of only a few suspected infarcts as most of the patients are very ill and transportation to the roentgen-ray laboratories of a hospital is contraindicated. The danger of liberating further emboli from the primary site of thrombosis is very real; hence, any extensive movement of the patient is to be avoided. Kohlmann, in 1924, was one of the first to give detailed reports of cases of infarcts diagnosed by the roentgen ray. He described 10 cases, most of which came to necropsy, in which the diagnosis was confirmed. The roentgenograms showed shadows as described. Most of his patients had decompensated hearts. There was predominant involvement of the right lung, particularly the right middle and lower lobes. In 2 cases the infarct was unsuspected clinically. The condition in one case was followed by means of repeated roentgenologic examinations over a period of several months; there was very little change in the appearance of the shadow. The patient finally died, and an infarct was found in the region suspected. Kohlmann concluded that in many cases the roentgen-ray picture of pulmonary infarct is recognizable and that in certain cases that are atypical clinically, it may be of great diagnostic aid. Unverzagt reported 3 cases of unusual interest. The patients gave clear histories of pulmonary embolism with infarction occurring soon after acute thrombophlebitis had invaded ancient varicosities of the extremities. Years afterward he found shadows in the lungs which he interpreted as organized infarcts at the time of examination. He directed attention to the residual thickened pleura, with adhesions that accompanied the shadows. In all of the cases the base of the right lung was involved. Casellas reported a case in which there was an annular shadow due to thickening of the pleura, which at necropsy had as its base a hemorrhagic infarct. Wharton and Pierson reported 9 cases of nonfatal postoperative pulmonary embolism in which they described what they considered pathognomonic roentgenologic signs of infarction. The first noticeable change they pointed out was clouding of the costophrenic angle; the rest of the lung was clear. They also emphasized that repeated films must be taken in many cases because, like the physical signs, the roentgenologic data may be scant even in the presence of marked constitutional symptoms. This paucity of data, they stated, is one of the characteristics of the disease. The clouding of the costophrenic angle usually appears within twenty-four hours after the onset of symptoms, when physical signs are very slight; hence they believe that the roentgen ray is of distinct value in early diagnosis. When a large vessel is plugged by an embolus large areas of increased density appear at the base. These areas, they say, are clearly defined and they consider this another characteristic feature. They expressed the belief that the opacity is less than that of the shadows observed in pneumonia. The increase or decrease in size of this area of density is concomitant with the patient's condition and if repeated, superimposed infarction takes place, and an area of increased density is found after each attack. Pleural changes take place in from four to ten days and become very marked. Many thickened bands develop. No matter how small the infarct, the pleura is always involved. The lung, they stated, usually clears up in ten to fourteen days, but the pleural changes persist a great deal longer.

REVIEW OF TWENTY-FIVE CASES

The foregoing covers, from a practical standpoint, the facts thus far known regarding pulmonary infarction. The chief

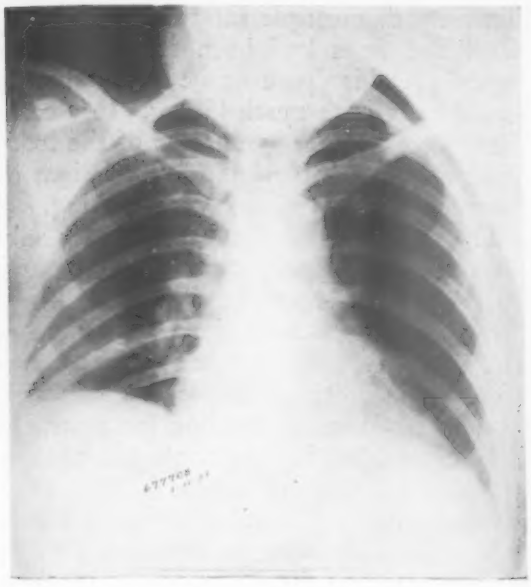

Fig. 4. Day of onset of pulmonary symptoms of pulmonary infarction and abscess formation following radical mastoidectomy. The triangular shadow can be well seen in the lower lobe of the right lung. In the medial portion of the shadow is an area with a moth-eaten appearance which represents abscess formation. There is dense clouding of the costophrenic angle and increased density at the periphery.

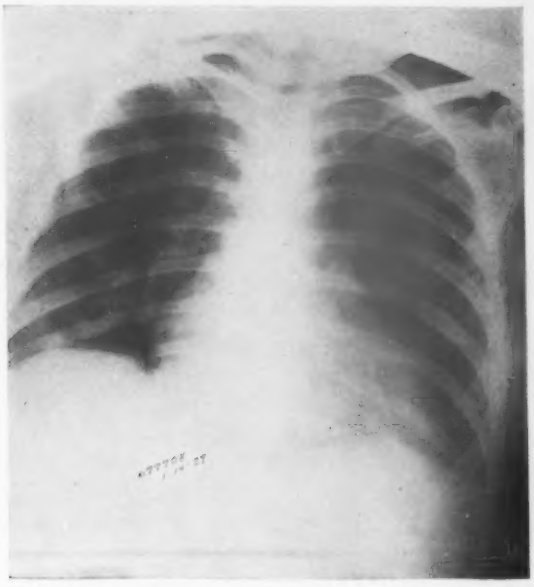

Fig. 5. Same case as that shown in Figure 4, three days later. Marked increase in the size of the abscess cavity is shown. The surrounding infiltration is well delimited and dense.

purpose of this study is the analysis of the salient features, from a clinical and roentgenologic standpoint, of 25 cases of pulmonary infarction, records of 8 of which were completed at necropsy. In 17 cases, the infarction took place following a surgical operation, and in 6 cases the accident occurred in patients suffering with cardiac decompensation.

Eighteen (72 per cent) of these patients had definite hemoptysis. It was present in twelve (61 per cent) of the 17 postoperative cases, and 5 of 6 of the cardiac cases. A pleuritic type of pain was present in 76 per cent (19 of 25). In the remaining 6 cases, the pain was slight or absent. A pleuritic rub was definitely heard in 44 per cent of the cases (11 of 25).

The time of infarction after operation averaged eight to twelve days. A premonitory rise of temperature was not constant. There was usually some rise of temperature (100° to 101.5°) on the day of the onset of the episode but practically never

Fig. 6. Same case as that shown in Figures 4 and 5, three days after the subsidence of all symptoms referable to the lungs. The marked diminution in the size of the abscess cavity is evident, although the surrounding infiltration is still marked.

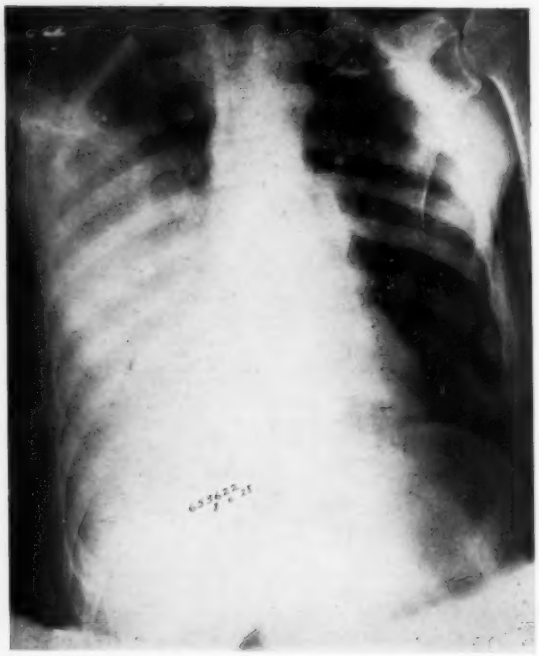

FIG. 7. Same case as that shown in Figure 12, five days later. Pain and dyspnea increased and it was necessary to place the patient in the oxygen chamber. A dense shadow is shown, occupying the entire right part of the thorax, except for a small area in the upper lobe of the right lung. Abscess formation and empyema ensued.

was there a curve, such as is commonly seen in bronchopneumonia, unless infection complicated the picture. In some instances, especially when there were multiple consecutive emboli and infarctions, there was no febrile reaction whatever. In the cases in which the leucocytes were counted, there was generally a rise from 12,000 to 18,000 for each cubic millimeter. The pulse rate was above normal in most cases.

The clinical demonstration of venous thrombosis, which could be the source of an embolus, was possible in 56 per cent of the cases (14). Two emboli probably came from the lateral cranial venous sinus, and six from femoral thrombosis or phlebitis. In 6 cases, mural cardiac thrombi were suspected because of the presence of serious myocardial injury. In 15 cases (60 per cent) there was fairly definite evidence clinically of multiple infarctions (Fig. 3); if all the cases had been studied pathologically, this percentage undoubtedly would have been much higher. In 2 cases there were definite symptoms of the lodgment of an embolus but physical signs or roentgenologic evidence were lacking.

The formation of abscess resulted in only 4 of 25 cases (16 per cent) (Figs. 4, 5 and 6), and in one case there was spontaneous recovery. Three patients died: one following rib resection for the treatment of empyema, one from infarction complicated by pneumonia and abscess, and one from cardiac disease resulting in infarction and abscess formation, following surgical operation. In 5 cases, enough pleural effusion developed to be of significance clinically (Fig. 7). In 13 cases, resolution and clinical cure took place without any evidence of abscess or other associated infection (Figs. 8, 9, 10).

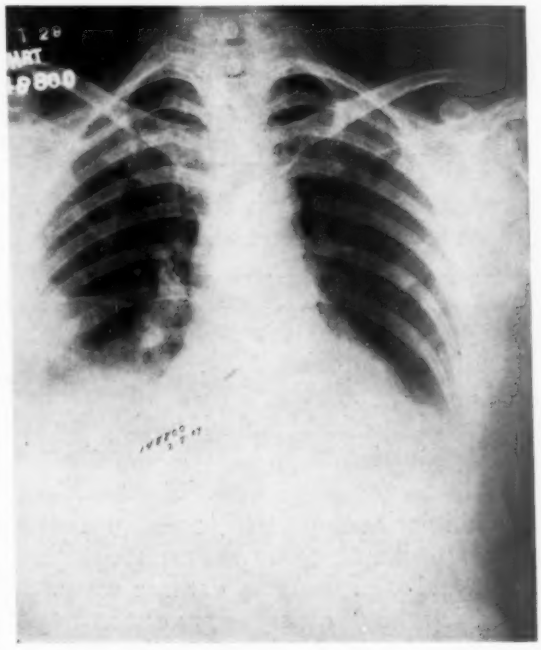

FIG. 8. Pulmonary infarction twenty-four days after the injection of quininurethane into varicosities of the extremities, and three days after the onset of pulmonary symptoms. A fairly well defined triangular shadow is seen in the lower lobe of the right lung with marked thickening of the pleura on all sides of the shadow, including the interlobar pleura. It is probable that some fluid is present.

In our group of 25 cases, definite changes were demonstrated in the roentgenograms in those cases in which there were physical signs of the condition and in some cases in which the physical signs were indefinite (Fig. 11). In 18 of the series the infarcts occurred at the base of the right lung as indicated on the roentgenograms (Figs. 8 and 12). In 3 cases the infarcts were in the base of the upper lobe of the right lung, in 3 they were in the left lung, in 4 they were in both lungs, and in 2 changes were not demonstrable in the roentgenograms. In practically every case some complication was present; thickened pleura was the most common, although in other cases the picture was so masked by pneumonic changes that it was impossible to distinguish the condition from bronchopneumonia. Clouding of the costophrenic angle was almost invariably found.

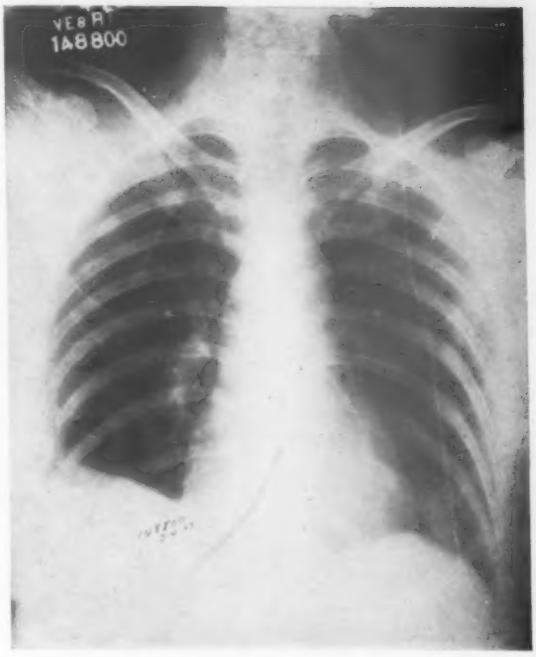

Fig. 10. Same case as that shown in Figures 8 and 9, twelve days after date of Figure 9. Almost complete disappearance of the shadows, except that the diaphragm has become adherent to the lateral thoracic wall.

COMMENT

It is our opinion, after reviewing the data in these 25 cases, that it is difficult, and at times impossible, to make a diagnosis of pulmonary infarction from the roentgenograms. With the clinical data, however, the nature of the shadows appearing on the films may usually be accurately determined. Infiltration at the bases, especially at the right base, associated with thickened pleura, are suggestive, especially if the infiltration is well defined and of triangular shape. However, these infiltrations may be poorly defined and diffuse. Early in the course of infarction, only clouding of the costophrenic angle may be seen. Another favorite site for infarction is the lower portion of the upper lobe of the right lung near the periphery and interlobar cleft. It gives rise to a wedge-shaped shadow such as has been described in the literature. Associated pleuritis of the peripheral and interlobar pleura undoubtedly takes place and is partly responsible for the shadow seen; hence the condition may be confounded

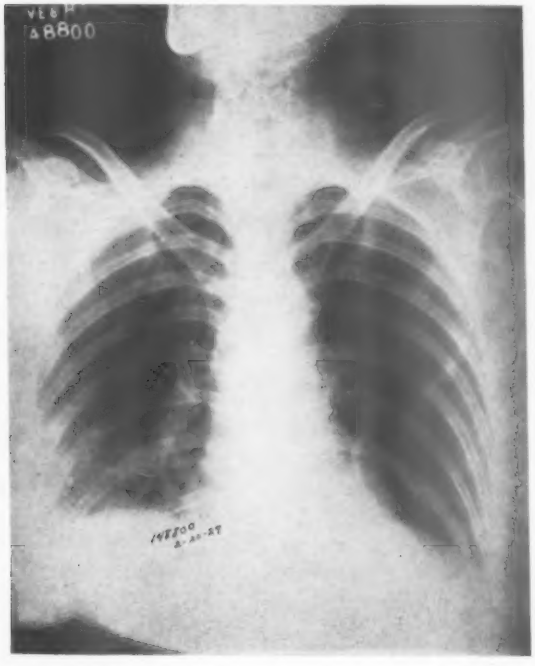

Fig. 9. Same case as that shown in Figure 8, thirteen days later. Marked diminution in density in the region of the lower lobe of the right lung is shown.

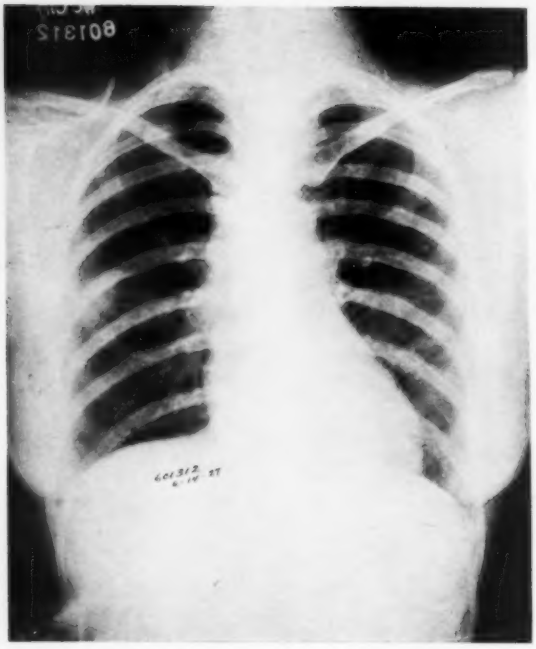

Fig. 11. Remote pulmonary infarction. Four months previously the patient had had femoral thrombophlebitis following a pelvic operation. A few days after the development of this complication, acute pulmonary symptoms developed abruptly, very suggestive of infarction. A round fairly dense shadow is seen in the center of the right lung near the pleural surface. Immediately above it is a horizontal, linear shadow, representing thickened interlobar pleura. Two months later this shadow was almost completely absent.

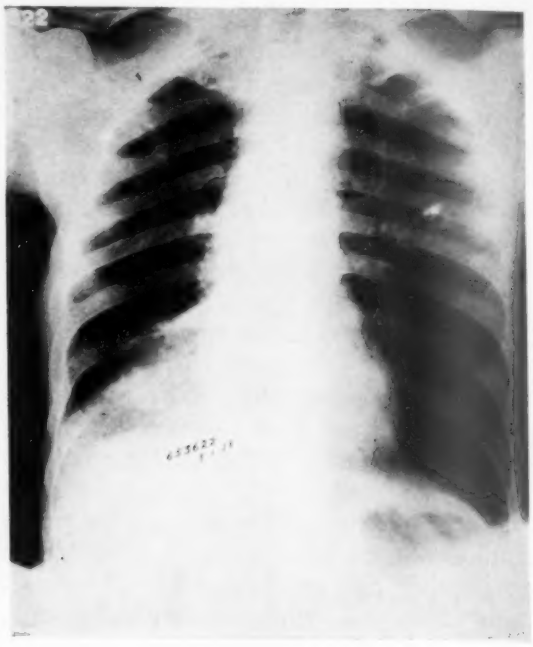

Fig. 12. Eight days after the appearance of pulmonary symptoms of pulmonary infarction which occurred nine days subsequent to excision of a gastric ulcer and posterior gastroenterostomy. A fairly dense shadow is shown in the region of the right lower lobe extending from the hilus to the right leaf of the diaphragm, with the usual thickening of the pleura.

with ordinary interlobar pleuritis. In certain cases, old, unresolved infarcts may be demonstrated by the roentgenogram when physical signs of the condition are not present. Roentgenographic examination is of aid in the demonstration of multiple consecutive infarctions and complications such as effusion, abscesses and empyema.

The combined use of clinical and roentgenologic data affords an effective method by which pulmonary infarctions and their sequelae may be recognized. Thoracentesis to determine the presence or absence of accumulations of fluid in the pleural space should be resorted to whenever there is any doubt, because of the frequency of large effusions and empyema in pulmonary infarction.

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DISCUSSION

Dr. Wm. H. Stewart, New York City. I wish to congratulate Dr. Kirklin on his ability to show some of these pulmonary infarcts. We have tried for years to do it, but have been successful in only a few cases. The exudate is of such a soft character that it is difficult to obtain any detail. We do, however, rely more on the after-effects, the complications of the infarct, as indicating the primary lesion. Most of the cases of the pulmonary gangrenes with or without cavities are due to pulmonary infarcts.

Dr. L. R. Sante, St. Louis, Mo. Our experience with pulmonary infarcts is similar to that of Dr. Stewart. We have tried in the St. Louis City Hospital where we have at our command immediate roentgenographic service, even bedside service, to examine such cases as show clinical evidence of infarction and we have never been able within a short time after the symptoms of infarction to show a definite area of consolidation. One case in which we planted seeds for carcinoma of the tonsils and buccal mucous membrane may throw some light on this subject. Four days after implantation the patient was suddenly seized with pain in the chest and showed all symptoms of a pulmonary infarction—bloody sputum, etc. There was no doubt from the clinical standpoint that we were dealing with an infarct. Roentgen examination was made several times during the first twenty-four hours, but no evidence of any pathological condition was ever found in the lung. Although we could hear râles a little later on, we could not see anything in the chest film. The clinicians were fully in accord that we were dealing with an infarction, that is, an embolus, but we were not able to see anything at that time in the roentgenogram. His symptoms subsided and he progressed satisfactorily for four or five days. After about five days we noticed at the periphery of the lung a zone of infiltration appearing; it looked more like a beginning tuberculous process in the interclavicular region on the left side which formed a triangular shape. About a week later he suddenly died after a gush of pus from the lungs. An autopsy showed that it was an evidence of infection following embolus and not to uncomplicated infarction. He died of secondary complication of pulmonary abscess.

TUBERCULOUS MEDIASTINITIS*

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INTRODUCTION

INVOLVEMENT of the mediastinum in varying degrees is a constant finding in all cases of pulmonary tuberculosis. In adults the lung involvement is usually the predominant one. During the past few years we have observed 5 cases in adults in which there was little or no evidence of pulmonary tuberculosis yet there was marked involvement of the mediastinum. Both the clinical and roentgenological findings were predominantly those of mediastinal disease. While tuberculosis of the mediastinum is usually confined to the tracheobronchial lymph glands yet in these cases we have reasonable evidence that the disease had extended beyond the limits of the lymph nodes to involve the various mediastinal structures, and because of this involvement we have termed the condition "tuberculous mediastinitis."

PATHOLOGY

Tuberculous disease involving the mediastinum is always primarily a disease of the lymphatic system. Warthin (Modern Medicine, Osler and McCrae) in discussing tuberculosis of lymph glands describes three types: (1) the miliary type; (2) the type in which there is a cellular hyperplasia with tumor formation, and (3) the type in which there is rapid caseation and softening. These are seemingly dependent on the virulence of the organism and the resistance of the host. There is no hard and fast line of demarcation between these types and more than one form may be present. Any of these may give rise to a mediastinitis.

If the disease remains confined to the lymphatic structures and the periglandular tissues, which is usually the case, the term mediastinitis is not justifiable. With a progressive tracheobronchial tuberculosis there may be an extension of the inflammation beyond the limits of the lymphatics to involve the areolar and fibrous tissue, as well as the various structures of the mediastinum and the mediastinal pleura. This constitutes a tuberculous mediastinitis.

Such a pathological condition may remain stationary for a considerable period of time or exacerbations may occur at varying intervals. Retrogression and healing may take place, or there may be a direct extension of the disease to the pericardium with pericarditis, and involvement of the myocardium and a myocardial death, as is shown by one of our cases. Invasion of the adjacent pulmonary tissue is apparently a common occurrence. Extension to and involvement of the spine with spondylitis and cold abscess formation is a possibility. Softening of the caseous glands may occur with cyst formation which may rupture into a bronchus, the pleura or pericardium, blood vessels, lymph vessels or through the skin. Such occurrences frequently terminate fatally.

A diffuse tuberculous involvement of the mediastinum is probably more common than is generally supposed, but due to the fact that it is usually accompanied by extensive pulmonary disease the mediastinal manifestations are given but secondary consideration. In the cases here reported evidence of mediastinal pathology was the outstanding feature and because of this, considerable difficulty in diagnosis was encountered. These cases have apparently carried latent tracheobronchial tuberculosis and 3 of them apparently healed pulmonary lesions. With the reactivation of

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

the tuberculous process there was a direct extension from the tracheobronchial glands to the mediastinal structures rather than a pulmonary invasion which is the usual course. In these cases it is worthy of note that while the disease in the mediastinum remained active for a considerable period of time there was little or no tendency to pulmonary extension.

SYMPTOMATOLOGY

The symptoms in tuberculous mediastinitis, as in most other forms of mediastinal disease, are chiefly those of pressure. Cough is usually the most frequently encountered symptom. It is uncontrollable, spasmodic, occurring in paroxysms often resembling pertussis. At times it is so severe as to induce vomiting. It may be brassy in character as in aortic aneurysm. Substernal pain may occur, but usually there is only a substernal discomfort that is difficult for the patient to describe. A dull pain in the interscapular region, however, is a much more common symptom. Dyspnea is usually present and also tends to be paroxysmal. Sputum is variable in amount and character dependent on pulmonary involvement and secondary infection. Three of our cases showed blood-streaked sputum at times. Hoarseness and aphonia are rather constant symptoms due to pressure on the recurrent laryngeal nerve. Dysphagia is occasionally complained of. The constitutional symptoms are those usually associated with clinically active tuberculosis—namely, fever and night sweats, loss of weight and strength, malaise and anorexia.

PHYSICAL EXAMINATION

The physical signs may or may not be definite. In the cases observed, a definite widening of the supracardiac dullness and interscapular dullness with increased transmission of voice and breath sounds over these areas was found. Smith's sign and d'Espine's sign are said to be of value. Cyanosis of the face and upper extremities with dilatation of the veins and at times edema may be found in extreme cases.

ROENTGENOLOGIC FINDINGS

The roentgen examination probably affords the best means of diagnosis. The roentgenologic appearance, however, is by no means pathognomonic and may even be misleading unless the possibility of a tuberculous mediastinitis be borne in mind. This is due to the fact that the roentgenologic features do not differ essentially from those of other forms of mediastinal pathology.

The characteristic appearance is a widening of the mediastinal shadow. This increase in width is usually the result of a bulge of the mediastinum to one side or the other. The outline tends to be smooth and regular, in contradistinction to the nodular appearance of lymph gland enlargements, as in Hodgkin's disease, or the globular appearance of many mediastinal tumors. The trachea may or may not be displaced. However, if a deviation of the trachea be present, we believe that the direction of the displacement is of some diagnostic value. The displacement of the trachea in tuberculous mediastinitis is towards the side of greatest involvement, while in mediastinal tumors it is usually displaced in the opposite direction from the tumor. This effect upon the trachea in tuberculous mediastinitis is probably only seen in chronic cases and is the result of retraction by fibrosis. In such cases, the adjacent pulmonary tissue may show some tuberculous invasion.

Tuberculous mediastinitis may occur without evidence of pulmonary involvement. The finding of a parenchymal lesion, however, tends to strengthen the suspicion of the tuberculous nature of the mediastinal pathology although it does not establish the diagnosis, since tuberculous lesions are so commonly found associated with other forms of mediastinal disease. Of the

same significance is the finding of enlarged and calcified tracheobronchial glands. These, however, may be obscured by the dense shadow resulting from the inflammatory reaction in the mediastinal areolar tissue and the involvement of the mediastinal pleura so common in tuberculous mediastinitis.

It seems entirely possible that a tuberculous mediastinitis may exist without roentgenologic evidence. Considerable pathology may be concealed in the normal mediastinal shadow. The disease must evidently progress considerably before there is an increase in the size of the mediastinum. Roentgen examinations made in the early stages of the disease may be entirely negative. Repeated examinations, therefore, may be necessary before the roentgen ray can be of aid in the diagnosis.

It is not usually possible to make the diagnosis of tuberculous mediastinitis from the roentgenogram alone. While the roentgenologic appearance may be highly suggestive, it is only by a close correlation with the clinical aspects of the case that the diagnosis is warranted. And even then, observations of the clinical course of the disease with repeated roentgen examinations at intervals may be necessary to establish the diagnosis definitely.

DIAGNOSIS

The diagnosis cannot be made on any single feature but is based on the symptoms, physical findings, roentgenologic features and clinical course. The history of a previous tuberculosis as shown by one of our cases is suggestive evidence. The finding of a positive sputum is of value, but we know that mediastinal tumors may occur in patients with pulmonary tuberculosis. The constitutional symptoms described may occur in mediastinal malignancy. Biopsy of cervical glands when they are present may give confirmatory evidence and aid in eliminating malignancy or Hodgkin's disease. Bronchoscopy is not contraindicated and at times gives valuable information.

TREATMENT

The treatment consists of a regular tuberculosis regimen of rest, forced feeding and fresh air in pleasant surroundings. Heliotherapy is of value but should be carefully regulated—either sun baths or ultraviolet radiation by artificial methods. Roentgen therapy using small doses may be of benefit. Surgery is indicated where there is suppuration, the result of secondary infection.

CASE REPORTS

Case 1. F. K., white, female, aged twenty-three, admitted to the Women's Surgical Ward of the University Hospital, December 14, 1922. She came to the Hospital because of a swelling on the left side of the sternum. Four weeks before admission she had first noticed a dull aching pain over the upper left sternal border. A week later, a swelling occurred in the painful area. There were no other symptoms except a gradually increasing weakness and loss of appetite. She had never been sick before.

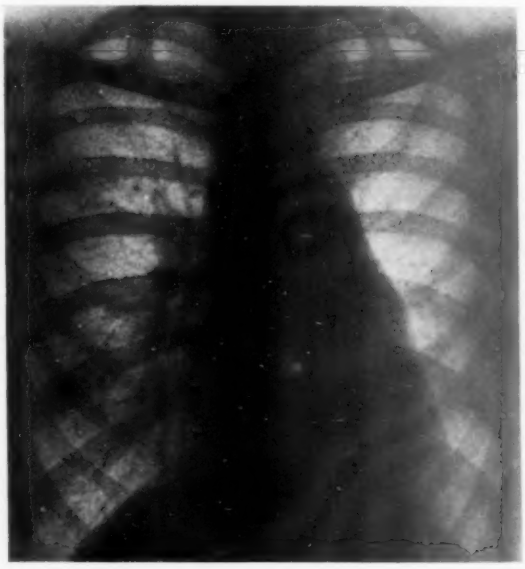

Fig. 1. Case 1. December, 1922. Reported as negative except for considerable widening of the aortic arch. It shows a definite widening of the mediastinum to the left. No evidence of pulmonary tuberculosis.

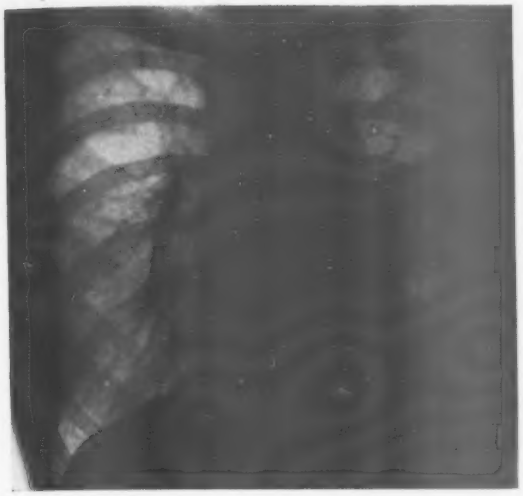

Fig. 2. Case 1. July, 1923. Reported as a widening of the mediastinum due to a tuberculous involvement of the mediastinal structures. Diagnosis based upon the clinical aspects of the case.

The physical examination revealed a smooth, hard swelling about 3 cm. in diameter at the costochondral junction of the third rib on the left side. It was neither red nor tender. There was an enlarged lymph node above the left clavicle.

A roentgen examination (Fig. 1) was negative, except that there was considerable widening of the aortic arch.

The following day the swelling on the chest was incised and considerable caseous-like material was curetted out. The cavity which was small, apparently extended deep into the thorax. The patient was discharged in about two weeks although the sinus remained open for some time.

In March of the following year, 1923, the patient was readmitted to the Hospital for a recurrence of the swelling at the site of the scar and an additional swelling a little above and to the left of the original one. At this time, she complained of general weakness, dull pains in both arms, more marked in the left, precordial pain, and pain in the interscapular region. She had developed a cough and expectorated some blood on various occasions. There was a choking sensation in her throat, some dyspnea and occasional night sweats.

The patient was again operated upon. An incision was made over the swelling and again much necrotic tissue was curetted away. A portion of a rib was resected. Cultures and smears made at the time of operation were negative. A pathological examination of the tissue removed was reported as acute inflammatory tissue. However, upon the basis of the nature of the lesion and the course of the disease, a clinical diagnosis of tuberculous mediastinitis was made. No roentgen examination was made during this admission.

The patient subsequently developed enlargement of the lymph glands of the left side of the neck, left axilla and mammary region. In May she was referred for roentgen therapy with a diagnosis of tuberculous cervical adenitis and mediastinitis.

In July, 1923, a roentgen examination (Fig. 2) showed a definite widening of the mediastinum, which was interpreted as due to tuberculous involvement of the mediastinal structures. No involvement of the lungs was noted.

The patient's condition improved under roentgen therapy. A roentgen examination made in January, 1924, showed no change in the general appearance of the chest. In June, 1924, the patient first complained of hoarseness.

The next examination (Fig. 3) in August, 1924, revealed a definite increase in the size of

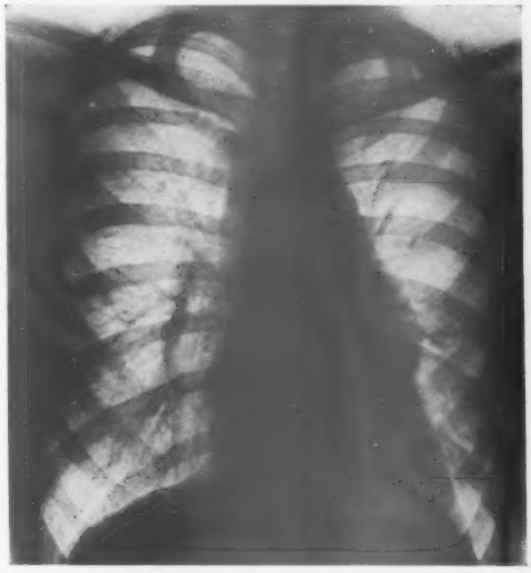

Fig. 3. Case 1. August, 1924. This examination shows a definite bulge of the mediastinum into the left hilus region.

the mediastinum. Clinically, however, the patient showed continued improvement and was gradually gaining weight, although pain in the chest was a conspicuous and persistent symptom. The hoarseness gradually became worse. A laryngoscopic examination in November, 1924, revealed a paralysis of the left recurrent laryngeal nerve.

The patient's condition remained about stationary until May, 1925, when she began to complain of aphonia, weakness, cough, dyspnea and pain in the chest. The cough was paroxysmal in character and so severe as to induce vomiting. She was admitted to the medical ward of the Hospital where a roentgen examination (Fig. 4) revealed a marked increase in the mediastinal pathology with extension particularly to the right. Although the patient had been under observation for two and one-half years there was still no pulmonary involvement that had been detected either clinically or roentgenologically.

She was discharged from the Hospital unimproved. She returned again two months later, all of her symptoms having increased in severity. Dyspnea was so marked that she had to be propped up in bed. She could not speak above a whisper. A roentgen examination (Fig. 5) at this time revealed, in addition to the mediastinal pathology, a tuberculous pneumonia and atelectasis of the right upper lobe.

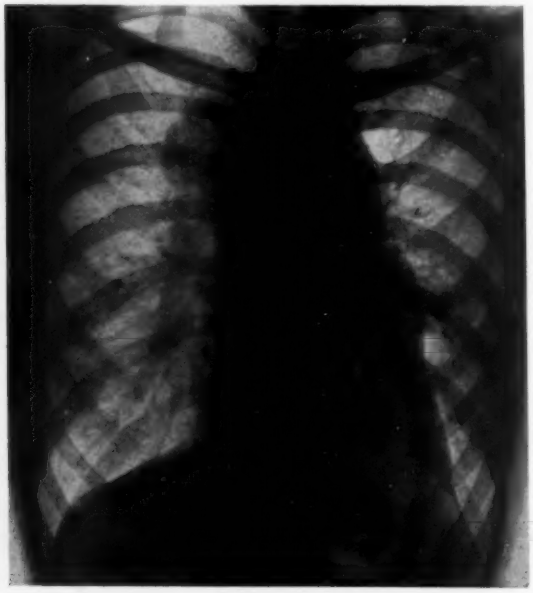

Fig. 4. Case I. May, 1925. A marked progression of the disease as evidenced by a definite widening of the mediastinal shadow to the right. Still no evidence of pulmonary involvement.

Fig. 5. Case I. July, 1925. In addition to the mediastinal disease there is a tuberculous pneumonia and atelectasis of the right upper lobe.

The patient became progressively worse. An examination made a month later showed a dissolution of the right upper lobe with beginning cavity formation and a widespread dissemination of the tuberculous infection throughout both lungs (Fig. 6). The patient died the day following this examination. No autopsy was obtainable.

Case II. F. W., white, male, aged fifty-seven. Chief complaint was cough. He had had this for eight months following a cold. The cough had become progressively worse, was uncontrollable, definitely brassy in character and came on in paroxysms. In addition, there was progressive malaise, anorexia and a slight evening rise of temperature. He had lost 35 lb. since the onset of the disease.

The patient had always enjoyed good health with the exception of some dyspnea on exertion and precordial pain of an anginoid character for the past two years. There was never any pulmonary complaint. In the family history there was recorded the death of one brother from tuberculosis and several ancestors from cancer.

Fig. 6. Case I. August, 1925. A dissolution of the right upper lobe with beginning cavity formation and a widespread dissemination of the tuberculous infection throughout both lungs.

On physical examination, the chest showed an increase to percussion of the supracardiac dullness, mainly to the right. The lungs were negative. There were a few small palpable cervical glands.

Repeated examinations of the sputum were negative for tubercle bacilli. Laryngoscopic examination revealed a limitation in motion of the right vocal cord. A roentgen examination (Fig. 7) showed an old tuberculous lesion in the left apex and a prominence of the superior mediastinum to the right. The diagnosis was a probable primary neoplasm. Bronchoscopic examination revealed a compression stenosis of the lower trachea and the orifices of both main bronchi due to an infiltrating lesion of the lower trachea and right main bronchus either inflammatory or neoplastic.

Most of the evidence was in favor of a primary neoplasm and on this basis roentgen therapy was instituted. The patient, however, did poorly under this form of treatment so that it was soon discontinued.

A second roentgen examination made a month after the first showed no change in the chest condition. A biopsy was done on a gland removed from the neck and this was reported as tuberculosis. The patient became progressively worse and died a cardiac death four months later. Sputum examinations, shortly before death, revealed tubercle bacilli.

An autopsy performed by Dr. Frank Lynch was reported as follows: "Tuberculous mediastinitis. Tuberculosis of the lung, pleura, pericardium, myocardium and peribronchial lymph nodes. The pulmonary tuberculosis seemed to be confined to that part of the lung adjacent to the pleura. There were also areas of bronchopneumonia apparently not tuberculous. There was sclerosis of the coronary vessels."

Comment. We have here a patient in whom the tuberculosis was predominant in the mediastinum and had spread to involve all of the mediastinal structures including the pericardium and heart and was unquestionably contributory to his death.

Case III. H. S., white, female, aged thirty-one. Chief complaint was cough. In the Spring of 1919, the patient complained of feeling tired, lost weight, and strength, and developed a slight cough with expectoration. Sputum examinations were positive for tubercle bacilli. She was placed under treatment and made a good recovery. The extent of the disease at

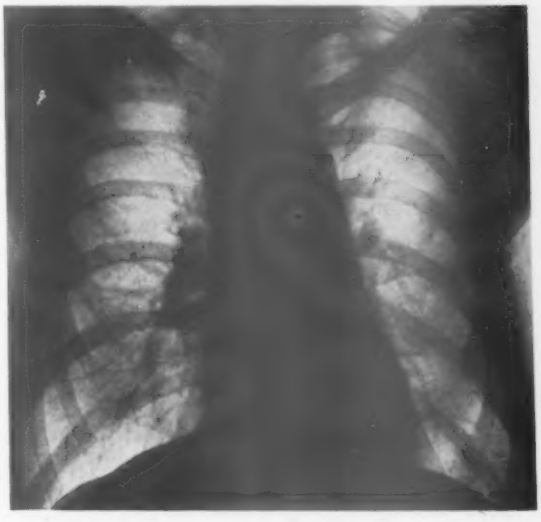

Fig. 7. Case II. An old tuberculous lesion in the left apex with a widening of the superior mediastinum to the right, interpreted as a primary neoplasm. Autopsy revealed a tuberculous mediastinitis.

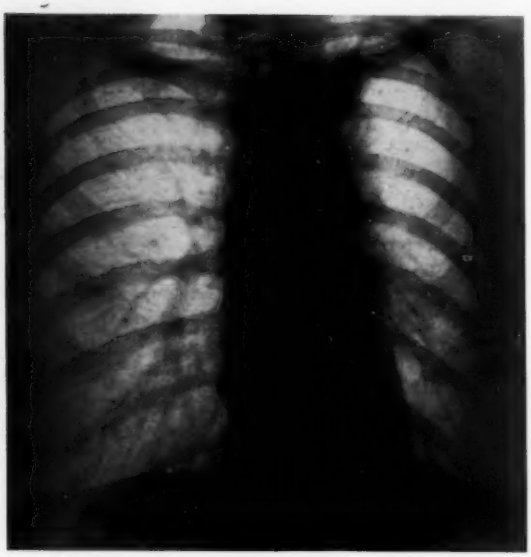

FIG. 8. Case III. July, 1928. Shows a definite widening of the superior mediastinum to the left with some thickening of the left apical pleura. Roentgenogram interpreted as a mediastinitis or mediastinal growth. Sputum was positive for tubercle bacilli.

that time is not known as no roentgen studies were made. She was well from 1920 to 1928 with the exception of a slight cough which was thought to be due to upper respiratory disease. During the Spring of 1928 the cough became progressively more troublesome and paroxysmal in character. With the cough there developed a heavy oppressive feeling in the chest which the patient had difficulty in describing. There was also increasing shortness of breath and occasional hoarseness.

The physical examination showed an increase in the supracardiac dullness to the left. The left lung showed impairment to percussion above the clavicle extending down to merge with the substernal dullness.

A roentgen examination (Fig. 8) in July, 1928, reported as either a mediastinitis or a mediastinal growth, showed a definite widening of the superior mediastinum to the left with thickening of the pleura over the left apex and up along the left side of the spine.

Sputum examinations were again positive for tubercle bacilli. The patient was placed on a tuberculosis regimen and many of her symptoms subsided. Repeated roentgen examinations at intervals have been made which for the most part have shown little or no change in the appearance of the chest pathology.

An examination made during a recent exacerbation showed a direct extension of the disease into the left upper lobe (Fig. 9). Rupture into a bronchus or the trachea had apparently also occurred as there was an attack during which considerable blood and pus was expectorated. At the present time the patient is at a sanatorium where she is gradually improving.

Comment. This patient has apparently carried a latent tracheobronchial tuberculosis since her original infection in 19 9. With reactivation of the disease in 1928, there was an extension within the mediastinum rather than a pulmonary invasion. Even now there is little evidence of pulmonary involvement.

CASE IV. T. W., white, male, aged forty-nine, missionary. This patient was first seen in December, 1928. His chief complaint at that time was cough. He had had Asiatic cholera in 1920 and since then he had not been entirely well. In 1921, he was studied at the Mayo Clinic. A report obtained from them on the roentgen examination made at that time is as follows:

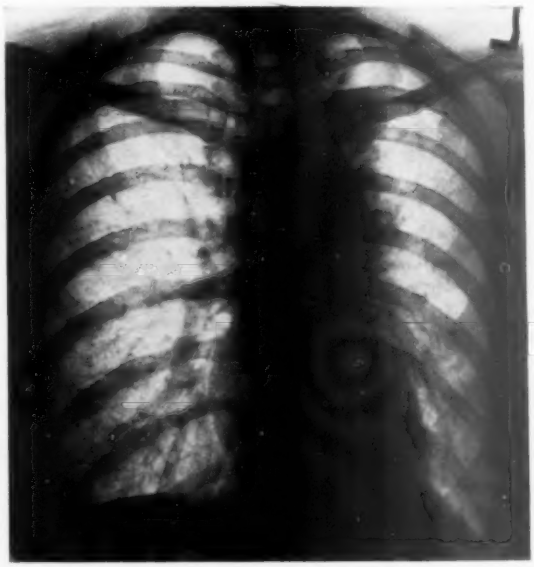

FIG. 9. Case III. Examination made during an acute exacerbation. There is now a beginning direct invasion of the adjacent pulmonary tissue of the left upper lobe by the tuberculous process in the mediastinum.

Fig. 10. Case IV. July, 1928. A marked tuberculous involvement of the superior mediastinum extending into the left lung field. Note the sharp border of the mediastinum on the left. There is also an old tuberculous lesion in the right apex.

Fig. 11. Case IV. November, 1928. An extension of the tuberculous process to involve the left apical pleura with a probable direct invasion of the adjacent pulmonary tissue. (Roentgenogram obtained through the courtesy of Dr. David R. Bowen, Pennsylvania Hospital, Philadelphia.)

"Old tuberculosis of the right apex; area of increased density in the left apex, left 1st, 2d, and 3d interspaces. This may be a small area of consolidation or may be fluid."

Since then he has had a slight cough and substernal discomfort, and some chest pain. In June, 1928, he had what was called influenza, which was followed by progressive loss of strength and weight, with slight fever in the evenings. The sputum was occasionally blood streaked. A roentgen examination (Fig. 10) was made in California in July, 1928. The report was, "Inflammatory thickening of the interlobar pleura of both the right and left sides. There is no evidence of tuberculosis."

The roentgenogram shows a marked increase in the width of the mediastinal shadow. The sharp outline so characteristic of enlargements to the left should be noted. Some of the enlarged mediastinal glands are well shown. There is some retraction of the heart and trachea to the left. An old tuberculous process is to be seen in the right apex.

Another examination made in California in September, 1928, had a somewhat similar appearance. The patient was next studied at the Pennsylvania Hospital, Philadelphia, November, 1928. A roentgen examination (Fig. 11) was made and reported as follows: "Probable tuberculosis of the right lung; probably an old tuberculous pleurisy at the left base; a large mass in the left apex which seems not to be aneurysm, and quite as unlikely to have originated as tuberculosis."

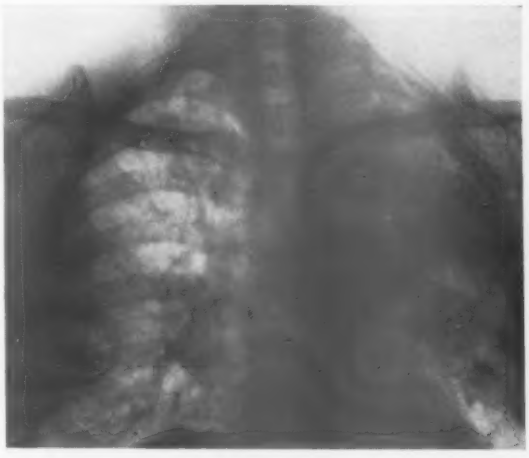

Fig. 12. Case IV. A recent roentgenogram showing a widespread dissemination of the tuberculous process throughout the left lung and some involvement of the right as well.

This roentgenogram shows a progression of the disease. There has been an increase in the involvement of the mediastinal pleura with an extension to the left apical pleura. Also there is evidently a direct invasion of the adjacent pulmonary tissue. There has been no change in the lesion in the right apex. Sputum examinations at this time were positive for tubercle bacilli.

The patient has since been under active treatment but in spite of this there has been a progression of the disease as indicated by a recent roentgen examination (Fig. 12). This shows a marked dissemination of the infection throughout the left lung and some involvement of the right hilus. This is probably the usual course of events and renders the prognosis very unfavorable.

Case v. The history, roentgenograms and autopsy report of this patient were obtained through the courtesy of Dr. Leroy U. Gardner and Dr. J. Woods Price of Saranac Lake, New York.

R. B., white, male, caught a cold in December, 1923, which was followed by a persistent cough. A diagnosis of tuberculosis was made in April, 1924. His symptoms were a loss of strength and weight, night sweats, cough, expectoration, dyspnea and fever, the temperature at times ranging between 100° and 102°. Sputum examinations were negative.

Fig. 13. Case v. July, 1924. A case of acute tuberculous mediastinitis. A widening of the mediastinal shadow with extension into both hilus regions, especially the left.

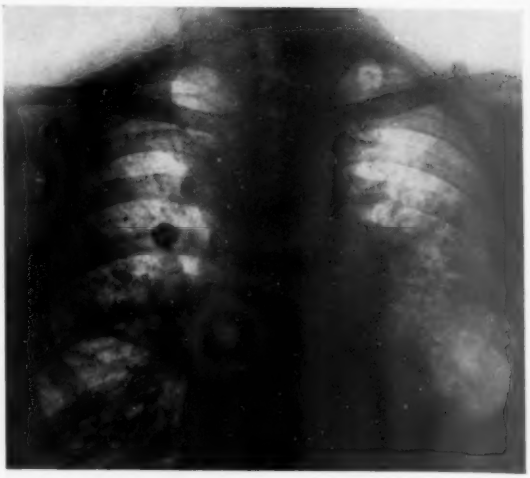

Fig. 14. Case v. October, 1924. A further extension of the pulmonary involvement. The patient died the following month. Autopsy revealed an extensive tuberculosis of all the mediastinal structures.

A roentgen examination made in July, 1924, shows a tuberculous infiltration in both root regions, more marked on the left side, and a definite widening of the mediastinal shadow (Fig. 13).

The patient became progressively worse. A second roentgen examination made in October, 1924, shows a widespread dissemination of the process from the roots into the parenchyma of both lungs (Fig. 14).

The patient died in November, 1924.

The essential features of the chest pathology as recorded in the autopsy report are briefly summarized: "The mediastinum was much widened and consisted of very dense scar tissue containing large amounts of fat in which were embedded many large caseous lymph nodes. Some of these had broken down to form abscess cavities filled with thin greenish pus. One such abscess had ruptured into the esophagus. The walls of the esophagus were largely occupied by caseous tubercles. The areolar tissue of the mediastinum was the seat of a chronic inflammatory reaction with many large tuberculous abscesses present.

"The pericardial cavity was completely obliterated and occupied by large caseous masses. There was a slight tuberculous involvement of the heart.

"Both lungs showed extensive tuberculosis without cavitation."

SUMMARY

1. Five cases of tuberculosis occurring in adults in which the disease was predominant in the mediastinum are reported.

2. The clinical aspects and roentgenologic findings were those of mediastinal pathology.

3. Attention is called to this localization of the disease as a distinct clinical entity.

4. The importance of tuberculous mediastinitis in the differential diagnosis of mediastinal disease is emphasized.

DISCUSSION

Dr. Eugene L. Opie, Philadelphia. It seems to me that this paper by Dr. Kornblum and Dr. Cooper is one of much interest because for the first time it establishes tuberculous mediastinitis as a clinically recognizable condition. I think it is evident from the pictures and the symptomatology that has been described that they are dealing with a condition which is from time to time recognized at autopsy. When I heard Dr. Kornblum's description, I called to mind instances in which I had seen the condition. The mediastinum is thickened and fibrous and there are extensive caseous areas. The lymph nodes are caseous and in one instance at least had broken their capsule so that caseous material had extended into the adjacent mediastinal tissue. It is noteworthy that in two of the cases of Dr. Cooper and Dr. Kornblum there was involvement of the lymph nodes above the clavicle, and in one instance tuberculosis was demonstrated microscopically.

As they point out, tuberculosis of the mediastinal lymph nodes is not tuberculous mediastinitis. The designation is appropriate only when the lesion extends into the adjacent cellular tissue.

With the infantile type of tuberculosis, the tracheal, bronchial and often the mediastinal lymph nodes are involved but with the usual type of adult tuberculosis, the lesion is in the apex and there is no secondary involvement of the lymph nodes. The infantile type of tuberculosis occasionally occurs in adults provided there has been no preceding infection. It will be of interest to note the character of the pulmonary lesion associated with mediastinitis.

I have seen one instance of mediastinitis in which there was tuberculous pericarditis by extension, perhaps from the mediastinum and as I understand there was pericarditis in one of the autopsies that were described by Dr. Kornblum and Dr. Cooper.

CHRONIC DISCHARGING SINUSES

THEIR VISUALIZATION ON ROENTGENOGRAMS*

By PAUL A. BISHOP, M.D.
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THE treatment of chronic discharging sinuses has always been a troublesome problem. Questions as to their point or points of origin, their ramifications and their size are difficult to answer. It is important that these factors be accurately determined before an attempt is made to finally eradicate such sinuses by surgical means.

Roentgenograms are often of great assistance in those cases in which the sinus arises from radiopaque foreign bodies and in some cases where the point of origin is in infected bone. In the majority of cases of the latter group it is difficult to make a proper interpretation of the various areas of increased or decreased density, any one or several of which may be the source of the discharge. These films are also found wanting in that they tell nothing of the sinus itself.

As a result of the shortcomings of plain roentgenograms, the injection of various opaque media has been tried with varying degrees of success, none of them being entirely satisfactory, as is suggested by the rather large number of methods that have been used. The most popular methods have been the use of suspensions of bismuth, solutions of the iodine and silver salts, and more recently the iodized oils.

The bismuth suspensions were at one time frequently used, but they are difficult to inject, present a definitely toxic factor, and at times seriously interfere with drainage of the sinus. Retained bismuth is occasionally seen in roentgenograms years after it has been injected. Dr. Bowen has suggested the use of iodide solutions, first irrigating the sinus several times with the solution to remove as much secretion as possible during the twenty-four hours preceding the examination, the final injection being made on the roentgen table. In the thicker parts of the body, however, the iodide salts in non-irritating strengths are not sufficiently opaque to be well visualized. The iodized oils seem to possess all the desired qualifications, being easily injected, non-irritating and non-obstructive. It has been suggested, I do not know with what authority, that they may have a beneficial therapeutic action. Their only disadvantage is their somewhat excessive cost. It is a method of injection of these oils that has proven satisfactory in a number of troublesome cases that I wish to present.

The majority of these patients are sent to the roentgenologist after a long period of watchful waiting. By this time the sinus opening has contracted to pencil point size and through it pus is more or less constantly discharging. To inject any media through such a small opening with no outlet for the displaced secretions and air is next to impossible by ordinary methods. Our own results were very discouraging. We have come to the conclusion that the best results are obtained by the injection of an iodized oil through radiopaque ureteral catheters. In any hospital catheters suitable for this purpose are easily obtained from the discards of the urological department, those with broken tips that make them no longer suitable for ureteral work. Those of as large caliber as is practicable in each case should be used.

Being of small diameter and flexible they are easily passed along the tortuous routes that most of these sinuses have and

* From the Radiological Department of the Pennsylvania Hospital, Philadelphia, Pa.

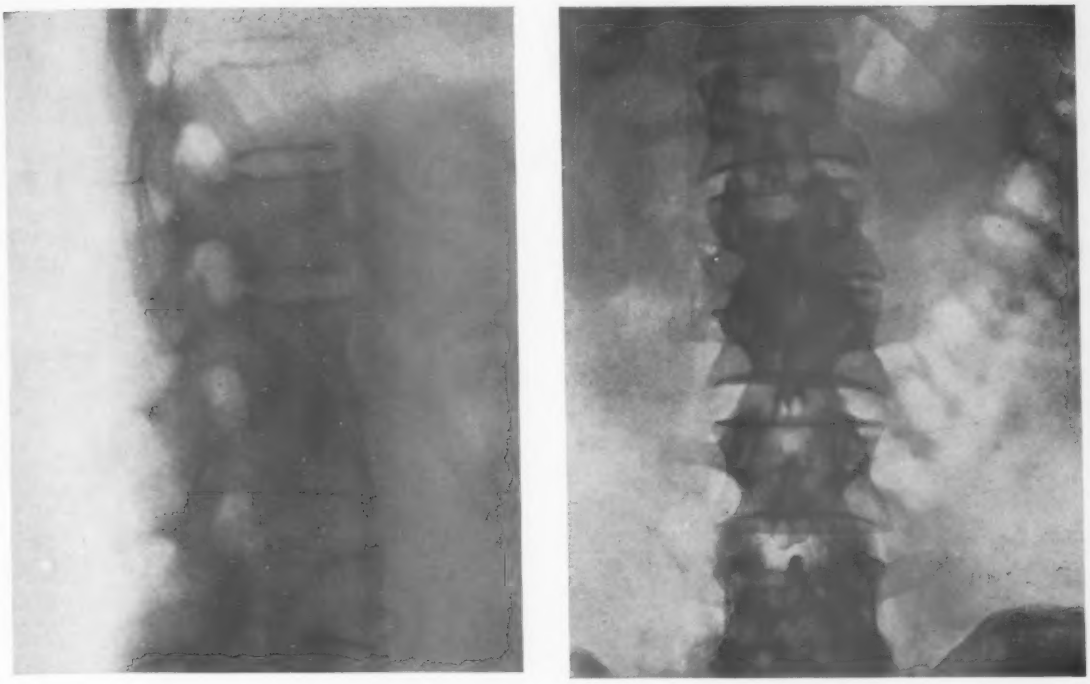

Fig. 1. Case 1. Lateral and anteroposterior views showing a destructive lesion, with some repair, between the bodies of the first and second lumbar vertebrae. Diagnosis, arrested tuberculosis with partial ankylosis.

if manipulation is gentle the procedure is usually painless. Another of their advantages is that they are calibrated in centimeters and in this way they are the means of accurately estimating the length of the sinus. Furthermore being radiopaque they themselves give valuable information as to the course of the sinus in addition to that furnished by the injected oil. They are most valuable, however, in that as the oil is injected the sinus fills from its deepest part and the secretions are displaced outward ahead of the oil, escaping around the catheter. We have found it best to "milk out" of the sinus as much secretion as possible before inserting the catheter.

As the value of the final results depends so much on the successful passage of the catheter, a consideration of a few of the difficulties may prove of value. It must be remembered that these sinuses are very irregular as to size and contour, being formed as they are by a combination of forces acting in varying degrees over a long period of time. In the first place there is tissue destruction, either traumatic, operative or otherwise, or by the infection. The pus thus formed seeks an outlet. It follows the course of least resistance, separating tissue layers, frequently going a considerable distance before meeting resistance sufficient to stop its progress and turn it back to break through at a weaker point elsewhere. Added to this is the disseminating effect of muscle action. These forces operate even after drainage has been established due to back pressure after the invariable contraction of the outlet in the course of time. By this time fibrosis throughout the sinus adds further distortion. As a result the sinus may have blind ending, finger-like projections, marked angulations and cavities of even considerable size. It is through such irregularities that the catheter must be passed and into

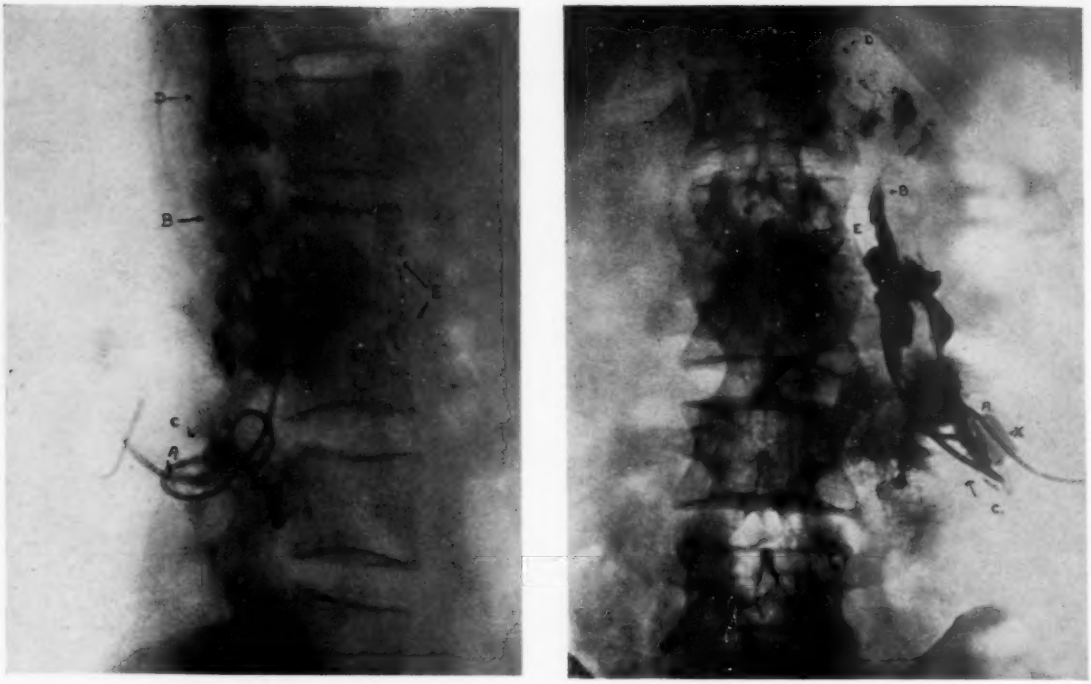

Fig. 2. Case 1 after injection of the sinus, lateral and anteroposterior views. A. Sinus opening. Note the shadow of the rubber nipple, X. B. Tip of catheter. D. Catheter coiled in cavity. D. Upper limit of the sinus. E. Oil in the defect in the anterior border of the second vertebral body.

which the oil must be injected to fully outline the sinus.

The catheter may pass into a blind pocket where it will be blocked, giving the false impression that the end of the sinus has been reached. If it is obstructed in a cavity of sufficient size it may coil on itself without finding an outlet. In this case there is a distinct "springy" feeling as the catheter is pushed inward, and on being released it forces itself outward a short distance. In some cases in which the catheter meets an obstruction the sinus proceeds at a more or less sharp angulation which can be followed only by careful manipulation, withdrawing it a short distance and reinserting it with rotation. Usually tactile fremitus will enable one to determine whether it is being obstructed by hard bone (frequently rough), or more or less resilient soft tissues. Roentgenoscopic observation has at times been of value. We have in at least one case made a preliminary injection of oil into such a cavity (Case 1). A part of the oil passed through the outlet and served as a guide for further manipulations.

It is hoped that this enumeration of difficulties will not give the impression that the procedure is too complicated and uncertain for practical use. On the contrary, they are cited and methods of overcoming them explained, to serve as a guide for procedure should they be met, and to emphasize the fact that with this method results can be obtained superior to those of other methods. Sufficient skill is easily acquired. Patience is necessary, patience of the kind shown by the cystoscopist as he meets with difficulty in passing a catheter into a ureter.

TECHNIQUE

All asceptic precautions are of course observed. The catheter is sterilized in formalin solution. It should be flushed

with the solution to aid in sterilization and to test the lumen for patency. It is rinsed in warm water to remove the formalin and to make the catheter more flexible. It is passed into the sinus until the deepest part of the tract has been reached. The catheter should then be cut off close to the sinus opening.

The iodized oil which has previously been warmed to body temperature is injected with a syringe. The dental type is preferable to the ordinary syringe in that it is stronger and has a more comfortable grip. Both of these features are of advantage, though not necessary, in applying the considerable pressure required to force the oil through the small lumen of the catheter. The needle of the syringe should be as large as can be inserted in the catheter. Secretions should be wiped away as they escape to disclose the presence of any returning oil. Injection is continued slowly until the secretions are entirely replaced by oil. We have found one oil on the market that is of much lighter body than others and is more easily injected.

A small rubber nipple such as is used on a cystoscope is slipped over the end of the catheter with its rounded end next to the sinus opening and is fastened firmly over the opening with adhesive plaster. The catheter is plugged with a match stick. The patient is now ready to be roentgenographed in any required position with a minimum loss of oil. Stereoscopic films are strongly urged, in two planes if possible.

CASE REPORTS

Case I. Tuberculosis involving the bodies of the first and second lumbar vertebrae. The roentgenographic appearance of the lesion has remained much the same during the ten years that it has been observed in this department (Fig. 1). There has been a discharging sinus in the left flank for fourteen years. At the time of this examination the opening of the sinus, (Fig. 2, A) was so small that it had to be stretched to admit the No. 6 ureteral catheter that was used. The sinus ran downward and

Fig. 3. Sinus from an old Brodie's abscess. In this case the opaque catheter gives more information than the injected oil. A. Opening of the sinus. B. Tip of the catheter. C. Perforation of the ilium.

outward for a distance of 4 cm. and at this point met with resistance. Repeated attempts to pass it farther were unsuccessful. A small amount of iodized oil was injected and a film made. This showed the catheter coiled in a small cavity, C, which was partially filled with oil, a small amount of which was shown to be extending upward and inward from the cavity. The patient was then placed on the roentgenoscopic table and the manipulation was continued between observations until the catheter passed the sharp angulation of the sinus and proceeded in the direction of the bone lesion to point B. Injection of the oil was then completed. Figure 2 shows the widespread distribution of the oil. It will be noted that the oil extends well above the lesion, D, and at the site of the lesion, passes through a sinus between the bodies of the first and second lumbar vertebrae to a defect in the anterior border of the second, E. These findings caused the attending surgeon to decide that surgical treatment, other than more complete drainage, was inadvisable.

Case II. (Fig. 3.) A small sinus opening slightly posterior to the anterior superior spine

Fig. 4. Submaxillary calculus. A. Opening of the sinus. B. Tip of the catheter. C. Calculus, surrounded by oil. D. Oil escaping through the duct into the patient's mouth.

of the right ilium. Duration, several years. In this case the sinus was found to have its origin around a small area of roughening and increased density on the posterior aspect of the ilium, just above the perforation of an old Brodie's abscess, C.

Case III. (Fig. 4.) This sinus drained from a small opening on the left side of the neck about 3 cm. below the angle of the jaw. It had persisted after a small fluctuating mass in the submaxillary region had been incised. The catheter was obstructed after it had been inserted 2 cm. The iodized oil can be seen surrounding a calculus in the submaxillary gland, C, and passing through the duct, D, from which it escaped into the mouth.

Case IV. This case of osteomyelitis of a femur presents the most extensive series of ramifications of a sinus that we have observed. The opening of the sinus, A, is at the top of the illustration and was but slightly larger than the No. 6 catheter, all of which was used. It is shown to have passed into the medulla of the bone in two separate and distinct places. One of these is at the upper end, C, and the other at the extreme lower, B. The importance of these findings in a sinus with so small an outlet for drainage is obvious.

SUMMARY

1. Plain roentgenograms of discharging sinuses are usually of limited value.

2. Roentenograms after the injection of opaque media give valuable imformation as to the course, the size, the extent, and the point of origin of the sinus.

3. Iodized oil of thin body, injected through a radiopaque ureteral catheter which has been passed to the deepest part of the sinus, is suggested as a method of choice for visualization of the sinus.

4. Cases are presented illustrating the value of the method and demonstrating that the size and location of the opening of the sinus are not indications either of the size of the sinus or of the location or extent of the causative lesion.

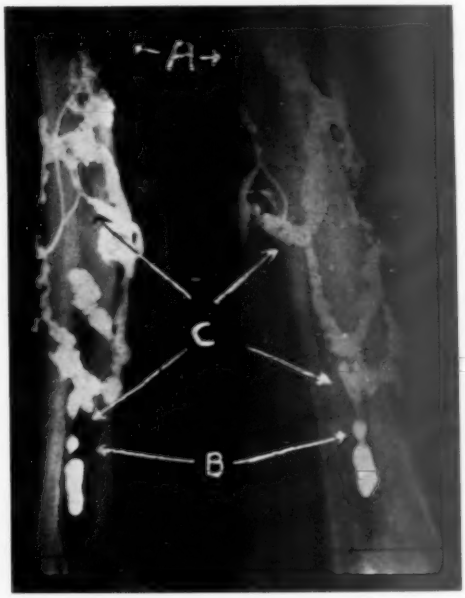

Fig. 5. Osteomyelitis of the femur. The illustration shows somewhat more than two-thirds of the shaft. The entire length of one ureteral catheter was passed into the sinus. A. Opening of the sinus. B. Tip of the catheter. C. Catheter and oil in the medullary canal.

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STUDIES OF THE SYSTEMIC EFFECT OF ROENTGEN RAYS

I. BLOOD CHEMICAL CHANGES IN DOGS FOLLOWING EXPOSURE TO FILTERED ROENTGEN RAYS OF SHORT WAVE LENGTH

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ROENTGEN rays have been used in medicine as a therapeutic agent for more than thirty years; however, the exact mechanism of their action on living cells is not known. In view of the systemic effect of irradiation, numerous investigations of the blood and its components have been undertaken for the purpose of demonstrating any regular changes occurring after exposure of the living organism to roentgen rays. These studies have included both animal experimentation and clinical observations upon man, in normal and in pathological cases. However, the results of several of the investigations are most contradictory. While it may be possible that some of these apparent discrepancies are due to a difference in the doses of radiant energy used, in the studies referred to before, no accurate deductions are possible in that respect. The majority of papers do not indicate the amount of radiation administered in reproducible units. In the face of such conflicting evidence, it seemed that a fairly extensive and systematic study of the effect of radiation upon some of the blood constituents of normal healthy animals might be a timely aid in the establishment of some unanimity of opinion upon this subject.

Before discussing our own experimental work, we shall review briefly some of the findings as reported by other workers in this field, beginning with the variations in the nitrogenous constituents of the blood. Hall and Whipple[9] found the total nonprotein nitrogen and the urea nitrogen usually increased much above normal shortly before the death of dogs exposed to lethal doses of roentgen rays. The urine nitrogen was markedly increased on the day following treatment and remained high until death which usually occurred within five days. Quite recently, however, Gigon and Lüdin[7] in reporting some researches upon rabbits showed that in healthy, well-nourished animals, the total nitrogen of the blood is decreased following exposure to relatively small doses of roentgen rays. In patients, these authors found less consistent results. Although the blood of irradiated persons always showed a definite alteration, the change consisted in either an increase or a decrease of total blood nitrogen, without any evidence of correlation. Jugenburg[12] noted a marked diminution in the nitrogen content of the feces and urine of guinea pigs exposed to radiation. The blood analyses failed to show the expected high nitrogen content. Upon analyzing the tissues of these animals, a great increase in nitrogen content was shown in the heart, the spleen, and the liver, as compared with the nitrogen content of analogous organs of untreated animals. Goodall,[8] in metab-

olism studies on leucemic patients, found that roentgen-ray therapy caused an increased elimination of nitrogen and of uric acid. Linser and Sick[16] reported that in 5 patients the urinary nitrogen was markedly increased and the uric acid output was tripled after irradiation. Cases studied by Murphy, Means, and Aub[21] showed a normal uric acid output. Matthews and Mazzola[19] found but slight increases in the blood urea and uric acid following irradiation. DeNiord and his coworkers[3] studied the effect of roentgen rays on the metabolism of cancer patients and observed that, in these patients as well as in the non-cancerous controls, there existed a moderate uric acidemia for a short period after exposure to roentgen rays. Schmitz,[24] working with cases of uterine cancer, reported that the urea and rest nitrogen showed the greatest increases. There was also a marked increase of uric acid in the blood immediately after irradiation. Hirsch and Petersen,[10] granting that variations in the amounts of nonprotein nitrogen constituents and other substances of the blood may result from roentgen-ray treatments, made a careful chemical study of the blood of certain hospital patients who were exposed to high voltage roentgen rays. Their examinations demonstrated no striking nor consistent alteration in the total nonprotein, the urea nitrogen, the uric acid, or the creatinin of the blood of these patients.

Numerous studies of the effect of radiation upon the chloride content of the blood have been made with a view to a possible correlation of an altered blood chloride with the roentgen sickness observed in some patients soon after treatment. Schlagintweit and Sielman[23] reported that the sodium chloride content of the blood was diminished immediately after irradiation. Kohlmann and Andersen[13] also showed that the sodium chloride content of the blood dropped immediately after roentgen treatment, then it gradually rose and within forty-eight hours, the pre-irradiation level was reached. Kolta and Förster[14] state that the sodium chloride content of the blood rises quickly from the low level observed shortly after irradiation and generally reaches the pre-treatment level within twenty-four hours, and many times within five hours. DeNiord et al[3] could not detect any change of the blood chloride content in a group of patients, either due to the presence of the cancer or to exposure to roentgen rays.

Most extensive have been the investigations as to the effects of roentgen rays upon the blood cholesterol content with the hope of demonstrating changes which might have some significance in explaining roentgen sickness. Levy-Dorn and Burgheim[15] observed that irradiation diminished the cholesterol content of the blood of healthy individuals while it generally increased the cholesterol content in the blood of cancerous persons. In a large, healthy dog and in patients with various pathologic conditions other than malignant tumors, irradiation was followed by a sudden fall of the cholesterol content in the blood, sometimes almost to the vanishing point. Radiation sickness occurred only when the blood cholesterol content dropped below the pre-irradiation level. Evidence quite to the contrary was recently presented by Hubert.[11] It appeared that irradiation of non-carcinomatous individuals, and of those who had been cured of cancer, led to an increase in the cholesterol content of the serum while irradiation of carcinomatous patients was followed by a reduction in the cholesterol content of the serum. Burgheim[1] later confirmed the work of Levy-Dorn and Burgheim,[15] stating that the occurrence of radiation sickness is accompanied by a low cholesterol content of the blood; administration of cholesterol tablets preliminary to roentgen-ray exposure prevented it. Luden[17] in her work on goats with roentgen rays concluded that a drop in the level of cholesterol was caused by irradiation. Mattick and Buchwald[20] observed a decrease in the blood cholesterol

after irradiation in a large percentage of the patients whom they studied, whether malignant or non-malignant cases. However they reported that this decrease is not sustained; there is a tendency for the blood cholesterol to rise to the pre-irradiation level after varying periods of time and in spite of repeated irradiations. Mahnert and Zacherl,[18] in a study of uterine cancer patients found an increase of the blood cholesterol content after irradiation. Strauss[25] likewise at first believed the blood cholesterol to be increased after irradiation but later concluded that it was diminished.

From even so cursory a consideration of the findings regarding the effect of radiation upon these constituents of the blood, one is impressed by the lack of agreement. We felt, therefore, that further investigations along these lines might be of value in answering the question more definitely as to whether there really is any constant and consistent variation in blood composition following exposure to roentgen rays. In this first study, the hemoglobin, the total nonprotein nitrogen, the uric acid, the sodium chloride, and the cholesterol were recorded.

EXPERIMENTS

In outlining the experimental procedure, all factors which might account for some of the discrepancies among previous investigations had to be carefully considered. One obvious difficulty is represented by the time periods elapsing between the irradiation and the chemical examination of the blood. Cori, Pucher, and Goltz[2] have shown by their experiments that, since the blood adjusts itself very quickly, marked changes in the blood occur only during the irradiation period or at very short intervals thereafter. Other workers have noted marked changes at twenty-four hours and by some, the alterations have been reported as sustained for several days or even weeks. In order to be more certain that the point at which any blood composition changes might occur would not be missed in this work, blood specimens were taken at frequent intervals—as soon as possible after the irradiation, twenty-four and forty-eight hours later, and one week, four weeks, and six weeks after the treatment. It also seemed desirable to keep the animals under observation for some time previous to the treatments, during which time blood chemical examinations were made for the purpose of determining the normal level for each individual animal, this level to serve as the standard by which to judge to what extent any deviation therefrom might be due to the irradiation. An accurate measurement of the dose applied also seemed of great importance.

Full-grown, apparently healthy dogs were selected as the laboratory animals least likely to undergo changes in blood composition due to the frequent taking of blood samples. These dogs were kept in the kennels on a constant diet for about two weeks before any blood examinations were attempted, to insure against any variations in blood composition due to dietary adjustment. Blood chemical examinations were made two weeks, one week, and six hours before roentgen treatment. A hemoglobin determination, Dare method, was made upon each blood sample to ascertain any evidence of anemia.

Blood samples, 10 c.c., were drawn from the femoral vein of fasting dogs into glass vials containing dried oxalate. The Folin-Wu system of blood analysis was followed for the determination of the total nonprotein nitrogen,[6] uric acid[5] and blood chlorides.[4] The protein-free filtrates were always prepared within fifteen minutes after the taking of the blood and the analyses were completed that day. Cholesterol estimations were made upon the blood by the Myers-Wardell technique,[22] with the exception that the blood, mixed with the calcium sulphate soon after withdrawal, was allowed to dry at room temperature over night. To insure against loss of any cholesterol determinations as a

result of brown chloroform extracts, all cholesterol determinations were run in duplicate. Any extracts showing the least trace of brown were discarded. When both extracts were of the desired green color, they were read in the colorimeter and their average recorded in the tables. A series of seventy blood cholesterols were run in duplicate for the purpose of determining how great a variation might be considered as within the limit of error of the method. The average variation* between duplicate samples was found to be 7.7 mg. per 100 c.c. of blood.

The roentgen exposure was carried out with a Kenetron apparatus and an air-cooled Coolidge tube enclosed in a lead cylinder; the technique corresponded to that used in deep therapy: 175 kv., 4 ma., 0.25 mm. Cu+1.0 mm. Al, 50 cm. focus skin distance, 10×15 cm. field, 28 min. The effective wave-length (Duane) lambda =0.165 Ångströms (transmitted through 1.0 mm. Cu); the strength of the beam amounted to 0.3 r per second (air value). It was determined with two ionization instruments of the thimble chamber type whose calibration had been checked against the large standard ionization chamber in connection with a galvanometer and standard cell. For a field of 10×15 cm., the back-scattering reached approximately 18 per cent. This leads, then, to a surface dose of about 600 r-units, which we consider a tolerance dose in human therapy. As the animals weigh considerably less than a human adult the volume dose for dogs is relatively much higher. The dose should, therefore, be sufficient to bring out changes in the blood following irradiation of the body. In order to study the influence of the dose and of the localization of the field, one group of dogs received twice the amount of radiant energy over the lower abdomen and the lower back, while in another group the chest was exposed. Due to the

* In three instances, there was a variation of 31 mg., while the majority of duplicate determinations did not vary more than a few milligrams.

TABLE I

HEMOGLOBIN

Group	Dog	Wgt. (kilos)	Pre-treatment			Post-treatment						Remarks
			2 wks.	1 wk.	6 hrs.	20 min.	24 hrs.	48 hrs.	1 wk.	4 wks.	6 wks.	
1	14	8.1	77	88	88	88	88	85	87	85	65	500 r (air value) over posterior lower body
	2	8.6	98	99	98	97	97	99	98	97	98	
	12	8.4*	94	89	90	90	90	90	90	94	94	
2	1	11.2	75	86	84	82	86	88	83	90	92	500 r (air value) over posterior lower body
	4	11.5	96	95	92	93	90	90	93	95	94	
	6	12.8*	94	90	90	90	88	87	90	96	94	
3	8	9.1	93	92	90	90	90	91	90	90	86	500 r (air value) over anterior and posterior lower body
	9	9.4	92	92	91	91	91	90	90	91	90	
	7	8.2*	98	96	92	87	86	84	83	90	94	
	10	7.4*	88	85	88	89	88	87	86	88	89	
4	7	8.6	90	94	100	100	100	97	98	99	98	500 r (air value) over posterior chest
	10	7.8	87	86	88	88	87	86	87	87	86	
	8	9.5*	90	86	88	86	87	86	89	88	89	
	1	12.4*	90	92	92	92	91	90	90	91	92	

* The dogs designated with an asterisk are the untreated controls.

fact that the rays emerged only through the opening of the lead cylinder, the exposure was strictly limited to the outlined ports of entry. The results of the biochemical studies are compiled in Tables I, II, III, and IV.

DISCUSSION OF RESULTS

The absence of appreciable changes in the hemoglobin content of the blood indicates that the bleeding of the animals for the purpose of obtaining the various blood samples did not cause any disturbance which might be an influential factor in itself (see Table I). As to the fluctuation of the total nonprotein nitrogen and of the uric acid, there were no characteristic or consistent variations in relation to the dose applied or to the part of the body which had been exposed. Warren and Whipple[26] reported that doses producing a lethal intoxication in dogs if administered over the abdomen were ineffective if given over the chest. In two dogs (No. 2 in Group 1 and No. 4 in Group 2, there was a definite increase of the nitrogen twenty minutes following the treatment. We tried to reproduce that change, but even an increase in the dose to four times its original order of magnitude was without success in that respect. In view of the quick return of the nitrogen level to the starting point and considering the inconsistency of the observation, we are not inclined to look upon it as significant.

The uric acid, in our experiments, remained practically the same, that is, the fluctuations were decidedly within physiologic limits (see Table II). A comparison with the untreated control supports this impression.

The sodium chloride level in dogs does not seem to be as constant as in man. An increase or decrease in the sodium chloride content of the blood following exposure must therefore be considerable in order to be regarded as an effect of the irradiation. The figures in Table III demonstrate, however, that the sodium chloride in the treated dogs did not fluctuate much; only one animal (Dog 9, Group 3) showed an increase in the sodium chloride twenty minutes after the exposure as compared with the determination six

TABLE II

Group	Dog	Wgt. (kilos)	Total Nonprotein Nitrogen (mg. per 100 c.c.)									Uric Acid (mg. per 100 c.c.)									Remarks
			Pre-treatment			Post-treatment						Pre-treatment			Post-treatment						
			2 wks.	1 wk.	6 hrs.	20 min.	24 hrs.	48 hrs.	1 wk.	4 wks.	6 wks.	2 wks.	1 wk.	6 wk.	20 min.	24 hrs.	48 hrs.	1 wk.	4 wks.	6 wks.	
1	14	8.1	35.3	36.8	36.5	48.3	41.6	42.0	52.0	61.0	41.6	1.1	1.3	1.1	1.3	1.1	1.0	1.3	1.7	1.0	500 r (air value) over posterior lower body
	2	8.6	36.5	40.0	38.0	60.0	39.0	40.0	63.0	50.0	48.3	1.5	1.5	1.1	1.5	1.3	2.3	1.3	1.6	1.3	
	12	8.4*	36.8	34.3	34.9	36.3	39.5	37.0	38.7	38.7	36.5	1.3	1.3	1.1	1.3	1.2	1.3	1.2	1.2	1.1	
2	1	11.2	34.7	37.5	37.1	40.0	36.8	36.5	36.6	36.8	38.0	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.1	1.4	500 r (air value) over posterior lower body
	4	11.5	50.0	50.4	42.8	69.0	52.0	53.0	42.8	47.6	47.2	1.2	1.2	1.2	1.5	1.4	1.4	1.3	1.4	1.4	
	6	12.8*	44.4	42.0	40.0	34.3	32.2	36.5	41.6	45.4	43.0	1.3	1.2	1.2	1.2	1.1	1.3	1.4	1.2	1.1	
3	8	9.1	34.3	34.7	36.5	39.5	38.4	39.2	40.5	36.3	38.0	1.0	1.2	1.1	1.1	1.1	1.1	1.2	1.4	1.5	500 r (air value) over anterior and posterior lower body
	9	9.4	70.5	60.6	62.5	65.0	62.5	62.5	60.6	60.6	60.0	1.0	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2	
	7	8.2*	30.9	31.0	32.4	32.5	31.0	30.7	32.5	34.7	44.0	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.3	1.2	
	10	7.4*	39.5	37.7	38.7	40.0	40.0	40.4	40.0	41.6	40.0	1.0	1.1	1.4	1.4	1.4	1.3	1.4	1.6	1.4	
4	7	8.6	34.7	35.0	44.0	44.0	44.7	44.0	43.0	42.0	40.0	1.2	1.3	1.5	1.3	1.2	1.2	1.2	1.2	1.3	500 r (air value) over posterior chest
	10	7.8	40.0	41.6	50.0	52.0	54.5	53.0	50.0	52.0	51.0	1.4	1.6	1.4	1.6	1.2	1.2	1.2	1.4	1.2	
	8	9.5*	40.0	36.3	38.0	37.0	38.7	36.0	39.0	38.5	38.3	1.4	1.5	1.5	1.2	1.2	1.2	1.4	1.4	1.2	
	1	12.4*	36.6	36.8	38.0	39.0	37.0	37.5	36.8	37.0	38.0	1.1	1.4	1.4	1.3	1.1	1.1	1.2	1.2	1.1	

* The dogs designated with an asterisk are the untreated controls.

hours before. On the other hand, the figures for one and two weeks previous to the treatment were as high as the post-treatment values. In this dog, the drop twenty-four hours after the exposure was followed by a slow return to the original level within four to six weeks. Since this observation stands out as a singular incident, we must conclude that, in our experiments, the sodium chloride did not change in any characteristic manner following irradiation. Roentgen sickness in man has been correlated with the drop of the sodium chloride level in the blood after deep roentgen therapy. As our animals did not show any signs of nausea, we should perhaps not expect a decrease in the sodium chloride content of the blood.

The variation in the cholesterol content of the blood before and after treatment is within the limits of error of the method (see Table III). In view of the rather general agreement in the literature concerning the cholesterol content of the blood following the exposure of the human body to roentgen rays, we carried out an additional group of treatments to verify our observations. Six dogs received deep roentgen therapy (air value: 500 r) over the posterior lower part of the body and the blood samples were taken two hours later. This time interval was chosen because, according to Levy-Dorn and Burgheim,[15] the drop in the cholesterol is usually at its maximum after that period. However, in only one animal (Dog D), did the cholesterol drop enough to be beyond the error of the method. The cholesterol level of all other dogs remained well balanced. The calculated mean values showed scarcely any variation (see Table IV). We cannot explain this apparent discrepancy between our findings in dogs and those reported in man.

SUMMARY

1. Fourteen dogs were exposed to filtered roentgen rays of short wave length over the anterior and posterior lower part of the body, over the posterior part alone, and over the posterior upper chest. The dose amounted to 500 r-units (air value),

TABLE III

Group	Dog	Wgt. (kilos)	Chlorides as NaCl (mg. per 100 cc.)									Cholesterol (mg. per 100 cc.)									Remarks
			Pre-treatment			Post-treatment						Pre-treatment			Post-treatment						
			2 wks.	1 wk.	6 hrs.	20 min.	24 hrs.	48 hrs.	1 wk.	4 wks.	6 wks.	2 wks.	1 wk.	6 hrs.	20 min.	24 hrs.	48 hrs.	1 wk.	4 wks.	6 wks.	
1	14	8.1	363	347	470	447	462	465	495	495	412	130	141	133	150	117	112	149	135	113	500 r (air value)
	2	8.6	330	300	445	495	472	380	495	445	346	108	104	116	126	143	130	115	145	116	over posterior lower
	12	8.4*	346	363	395	385	362	378	385	362	379	108	104	102	109	112	110	122	116	123	body
2	1	11.2	330	495	350	330	429	430	460	380	412	134	128	133	160	142	131	137	146	144	500 r (air value)
	4	11.5	445	396	380	379	429	231	363	361	363	137	128	144	158	133	146	144	181	178	over posterior lower
	6	12.8*	346	330	383	330	330	343	396	342	363	111	112	112	142	113	113	146	169	160	body
3	8	9.1	380	390	347	363	379	346	363	379	412	225	222	260	245	230	242	244	280	280	500 r (air value)
	9	9.4	412	429	330	429	247	363	394	346	462	164	167	166	179	180	180	180	180	180	over anterior and
	7	8.2*	330	330	363	330	363	394	362	330	363	179	180	190	195	193	172	176	180	174	posterior lower
	10	7.4*	380	346	360	363	412	346	362	379	379	155	158	145	144	154	160	155	184	184	body
4	7	8.6	362	330	363	363	412	412	385	370	365	172	176	240	235	220	215	207	200	212	500 r (air value)
	10	7.8	362	379	379	412	412	412	310	386	380	160	165	184	184	180	190	200	201	195	over posterior
	8	9.5*	363	379	412	379	462	462	412	382	378	242	244	280	285	250	247	230	235	240	chest
	1	12.4*	460	380	412	412	412	412	412	415	416	137	146	174	180	191	200	200	195	194	

* The dogs designated with an asterisk are the untreated controls.

Table IV

Dog	Weight (kilos)	Cholesterol mg. per 100 cc. blood		
		48 hrs. before roentgen treatment	6 hrs. before roentgen treatment	2 hrs. after roentgen treatment
A	17.5	191.0	192.2	188.0
B	19.0	192.0	193.5	210.5
C	21.0	224.3	230.7	222.2
D	15.0	235.3	222.2	177.7
E	11.0	235.3	240.0	237.6
F	12.0	195.3	187.5	205.1
Mean values		208.9	211.0	206.9

the surface dose to approximately 600 r per field. Six additional dogs served as controls.

2. The hemoglobin, the total nonprotein nitrogen, the uric acid, the sodium chloride and the cholesterol in the blood did not show any characteristic changes following irradiation. There existed no apparent relation between dose, part of body exposed, and effect.

3. As far as the discrepancy between our findings in normal dogs and those in pathological cases in man are concerned, we feel that only a comparative study on healthy persons can offer an explanation.

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EXPERIMENTAL INVESTIGATION OF LEAD THERAPY*

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THE demonstration by Blair Bell of Liverpool that a certain number of inoperable cases of carcinoma or sarcoma could be cured for a period of from one to seven years by the intravenous administration of certain lead preparations was a discovery of the first importance. Hitherto, with the exception of Coley's fluid, of which the therapeutic benefit is extremely limited, there has been no successful medical therapy for cancer. The fact that the method is not applicable to all types of cancer or that it has failed in the hands of other workers, has nothing to do with the question. The mere fact that Blair Bell has a certain number of well-observed and completely arrested cases of carcinoma and sarcoma, in which the growth has receded under treatment with lead alone, cannot be discounted because of the failure of other workers in the field to obtain satisfactory results, nor can the weight of observations on human cases be diminished by the fact that the lead is not effective as a cure of animal tumors. Whether this discovery by Blair Bell will ultimately lead to a generally available therapy of cancer cannot of course be answered now, any more than it would have been possible to prognosticate from Ehrlich's rather unfruitful therapeutic experiments with dyes the production of salvarsan. There are also three very practical reasons why the search for an agent of therapeutic value in cancer will be much more difficult than the production of an agent of destruction to a foreign parasite like the spirochete of syphilis. The first of these reasons is that in no country in the world, except perhaps in Germany, will the unrivaled facilities of the great chemical firms and their experienced staffs be placed fully and generously at the service of a scientific investigator. Secondly, the spirochete of syphilis is a single organism, and though it may vary in its local effects in the human economy, it is a foreign parasite with a different chemical structure from the rest of the tissues of the human body in which it exists, while the cancer cell is a parasitic cell which so far as our present knowledge goes is of exactly the same composition, with approximately the same metabolic activity as the normal cell from which it springs. Despite Warburg's contention that he has established a definite metabolic difference between the cancer cell and the normal cell, recent experimental work is pointing more and more to the fact that many normal cells can carry on the same type of metabolism which he postulates as characteristic of cells of the malignant tumor. It is merely a question of rate of growth and adaptation to special conditions. Thirdly, cancer is not a single disease but a pleomorphic growth phenomenon which, for lack of knowledge, has been grouped under a single head. The discovery of a cure for lymphosarcoma, then, offers no certainty that the same substance will cure a squamous cell epithelioma. These points, so long insisted upon by Dr. Harvey Gaylord of the New York State Institute for the Study of Malignant Disease, are apparently not fully appreciated by biologists or many of the research workers who are studying the subject of cancer. The clinical student of the disease has long recognized the extraordinary difference which exists between human neoplasms.

In the face of all these difficulties, the outlook may be discouraging, but that is only an additional urge for a renewed study of a disease which is fast becoming the chief cause of death in the civilized world. In-

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stead of vaguely roaming over the field and giving to animals or human beings with tumors a nondescript series of chemicals, without the slightest scientific basis for such administration, which is certain to prove a waste of time, a careful scientific study must be made on the fundamental biology of the cell. Nothing has been more misleading than the faith that by the Edisonian method of trial and error, something will be achieved by industry alone. The fact that centuries ago a native Peruvian discovered that quinine was an effective remedy for malaria is a brilliant exception, but here again it is a foreign parasite, wholly different from the rest of the cells of the body, which has proved to be susceptible to an alkaloid. Such a lucky shot may not occur again. Rather we should pursue the method of Ehrlich and study the biology of the cancer cell more industriously, and follow leads which like Blair Bell's offer some possibility of development.

Bell himself has been hampered by lack of funds in planning a broad-gauge research program. Obviously any advances in the future must be accompanied by the combined labors of chemists and biologists, using transplanted animal tumors as a primary test object.

If anything can be obtained which will cure mouse sarcoma No. 180 or rat sarcoma No. 10 of the Crocker Laboratory, we are in sight of the conquest of cancer. The growth-rate of these tumors is, however, infinitely greater than that of any human neoplasm. They may in a very few weeks grow to such size as to weigh nearly as much as the host which carries them. So that it is no wonder that lead is ineffective in checking these highly selected and perfectly adapted cells growing in an organism otherwise healthy and therefore supplying ample food for cellular proliferation. Nevertheless these animal tumors are very useful in checking the toxicity to the tumor of lead preparations.

The general toxicity is first checked by determining the lethal dose to healthy rats weighing 60 to 100 grams.

The lead compound should be injected intravenously, preferably giving the equivalent amount of lead as element. As control, the original Blair Bell suspensoid, which contains large quantities of lead hydrate and carbonate should be used. Its minimal lethal rat dose is about 1 mg. per 10 gm. of rat. If the rat has previously been grafted with a rapidly growing neoplasm, which does not spontaneously recede, the tumor toxicity will simultaneously be determined. The effects of such a dose are to cause more or less necrosis of the center of the tumor. Careful controls are necessary as these tumors tend to necrose spontaneously owing to their rapid growth and the consequent inability of the blood supply to keep up with the growth of the tumors. In the large blood sinuses in such tumors spontaneous thrombosis not infrequently occurs and by the injection of adrenalin or similar vasoconstrictors the amount of necrosis can be increased.

When injected intravenously only two preparations produce as intense a tumor necrosis as does the original Blair Bell preparation. One of these is manufactured under the trade name of Colosol; the other is a preparation made up for experimental purposes which is a compound of glucose and lead. The Colosol contains mercury in addition to lead and has considerable toxicity to the kidneys when injected intravenously. The Blair Bell lead seems to attack the liver chiefly. The glucose compound is highly toxic, partly because it is soluble; it acts very destructively on the liver and also has a considerable capacity to destroy tumor tissue. If a tumor of moderate size, say 1 cm. in diameter, is cut across twenty-four hours after intravenous injection with 4 or 5 mg. of Blair Bell lead or 1 mg. of lead as Colosol or 1 to 2 mg. of lead combined with glucose, the center of the tumor will be found to be transformed into a reddish necrotic mass. Microscopic sections show that the

periphery of the tumor into which the main blood supply pours from the surrounding vessels, often contains a considerable number of viable cells, and from these cells later a recurrence takes place. No other preparation tested is as effective as the three enumerated. Yet it is still not finally determined whether the destructive action as measured on animal tumors is exactly parallel with the therapeutic value to human neoplasms. Most of the facts so far observed point however in that direction.

In a report made to the London Cancer Conference last Summer, I showed that the addition of a certain amount of roentgen radiation was capable of carrying on the work of the lead and completing the destruction of the tumor, and I estimated roughly that the lead added 10 per cent to the effectiveness of the irradiation. This is not constant, probably because the lead effects vary in different tumors even of the same type. It is easy to imagine, though very difficult to prove, that in one tumor the circulation of a certain portion may be accidentally much more damaged by the lead which reaches it than another portion. The thrombosis of a single vessel may dominate the situation. In another tumor three or four vessels may feed the neoplasm and if only one is thrombosed, only the portion of the growth supplied by the damaged vessel will be destroyed. In addition to the thrombosis there is, with lead at least, a certain amount of direct toxic action, for while the soluble salts are rapidly changed into phosphate, unquestionably a certain portion remains in an ionized state for a time and continues to damage the cells outside the capillaries. The amount of lead which reaches the tumor as compared with that which gets to the liver, kidneys and other organs of the body is variable and probably depends primarily on the proportionate blood supply. Bell has shown by an analysis of human material that considerable lead is always demonstrable in a tumor, but that the quantities so obtained vary considerably. This may be the reason why he has found that certain types of tumor, like the squamous cell epitheliomata of the oral region, are less favorably affected than the highly vascular sarcomata. It is probably the reason why the slow-growing tumors of the gastrointestinal tract are scarcely influenced by lead, while ovarian carcinomata, spreading through the vascular omentum, often react favorably.

In all cases it must be frankly recognized that tumor cells are only different from normal cells in their rapid growth rate and irregular blood supply and that therefore their destruction can only be expected from an amount of lead which seriously damages the liver, which all my analyses have shown to contain a large amount of lead relative to tumor and other organs. This is quite in line with a large series of analyses of organs from demonstrated cases of death from chronic lead poisoning. There is apparently no elective absorption of lead by the tumor, and the lead cannot be demonstrated in the individual cells of the neoplasm. It is apparently seized by the reticulo-endothelial structures in the tumor, just as it is seized by the same structures in the liver, in the spleen and in the kidneys, damaging the walls of capillaries, and the cells which phagocyte it. As the soluble compounds are broken down and ultimately altered into an insoluble type of lead phosphate, one would expect no better and no worse results than these. Certain organic compounds have been shown to be extremely dangerous inasmuch as they are soluble in the brain lipoids. This is well known to be the case with ethyl lead which in quantities too small to damage the liver and other organs may produce serious brain symptoms owing to the selective absorption by the brain lipoids. Certain organic compounds which I have tested have shown a relatively large amount of lead in the brain of experimental animals, thus pointing out that the obvious step toward the perfec-

tion of lead therapy is not necessarily along the line which Ehrlich perfected in the production of salvarsan, nor has the question been answered as to whether a less toxic product will prove as valuable as the more toxic type. That we must poison the patient to poison the tumor suggests that search might profitably well be made toward a more toxic product in order that the same amount of poison might be obtained without loading the body with large quantities of lead.

Martland's experiments with a lead colloid, which was practically non-toxic in small doses showed only that the patients could be killed by large doses of lead without their tumors being influenced. On the other hand, the original Blair Bell product is so highly poisonous that only small quantities can be administered, scarcely ever more than 600 or 700 mg., while Martland gave 2500 mg. of lead.

The problem is still more complicated by the fact that one patient or even one animal is promptly poisoned by a dose which others will tolerate. One patient will develop an astounding anemia after the injection of 100 mg. of lead, while in others the blood will scarcely be altered by such administration. In animals we can control conditions better by selecting those of the same weight and strain, but even in mice and rats there is considerable difference in the toxicity of the same amount of lead intravenously administered. This intravenous administration is done in both mice and rats quite as easily as in the rabbit. The tail vein is used and a very fine needle employed, as the vessels are small. Rats are more difficult than the mice as the tail is apt to be covered with a thick epidermis which makes it difficult to see the vessel and may blunt the point of the needle. It is sometimes advantageous to soften the epidermis with soap and water or make it more transparent by rubbing in xylol, though this is not necessary in a mouse.

An important question yet to be investigated is to determine if possible whether one lead preparation is more freely absorbed or fixed by the tumor than another. Martland was unable, for example, to find any lead in the human tumors which he treated, and Reinhard and Buchwald* report similar findings in mice bearing spontaneous tumors.

Martland's sections however showed black particles, presumably lead, in the endothelium of the blood vessels of the tumors, and, therefore, presumably, if a sufficiently delicate analytical method had been used, lead would have been found.

The nature of the problem is evident from the fact that, let us say, 1 mg. of lead is given to a mouse weighing 20,000 mg. If the tumor in that mouse weighs, say, 1000 mg., and the distribution is equal throughout the whole body, a chemical method must be devised to discover 1/20 of a milligram; but as a matter of fact the distribution is not equal. The liver often takes one hundred times the amount of lead that is absorbed by the tumor, hence the analytical method must detect 1/2000 of a milligram, an amount which escapes ordinary analysis. Similarly in a rat weighing 100 grams, with a tumor weighing 1 gram, after injection of say 4 mg. of lead, the quantity allotted to the tumor will be very small and the analyst must be prepared to detect that quantity. As a matter of fact, neither Martland nor Reinhard and Buchwald used methods sufficiently delicate to detect these small quantities of lead. It is, however, perfectly easy to demonstrate lead in the tumors of treated animals. In fact, a faint trace of lead can be demonstrated in the heart muscle of a mouse or rat after the injection of 1 mg. of lead, and much more in the tumor. The method is an old one. It was used in 1865 in the medicolegal detection of thallium, and has recently been brought to considerable perfection in the

* Reinhard, M. C., and Buchwald, K. W. No lead in tumor tissue after intravenous injection of colloidal lead. *J. Cancer Research*, 1929, *13*, 239–241.

analysis of special steels and similar material by Hartley and Pollak, and the French chemist de Gramont. The method for our purpose is to ash the tissues, adding, if necessary some lead-free nitric acid to complete the destruction of all organic matter, and then electrolyze a given quantity of an aqueous solution of the ash, using 5 ma. of current. The electrolysis is very conveniently carried out in short test tubes holding about 10 c.c., through the bottom of which a platinum wire has been fused. This should be made the positive pole. The negative is a piece of gold wire about 18 gauge. If large quantities are expected it is well to use two or three wires in the solution, if small quantities, one wire is best. After the electrolysis is completed, which takes six to eight hours, the lead which is adherent to the end of the gold wire is volatilized in a condensed spark from a 10kv. transformer with a capacity made up of two or three wireless condensers and a small self induction coil to remove the confusing air lines. One ten-thousandth of a milligram of lead can be detected without difficulty by this procedure. The spectrum has to be photographed as it lies in the near ultraviolet and there is a set of convenient gold lines which mark out the region in which the characteristic lines from traces of lead appear. By making a series of negatives from known lead solutions, an approximation can be quickly made as to the quantity of lead present in a given amount of solution. As I have stated, it is always possible to detect lead in any type of tumor, either primary or inoculated in an animal which has been given no more than a milligram of lead of any type which I have tested. The quantities found vary with different tumors, and even with the same tumor. Such an analytical method permits a study with a minimum of labor of the distribution of the lead in the liver, the spleen, the kidneys, the bone marrow and a tumor. It permits an estimation of the rapidity by which the lead disappears in the circulation, and a number of other interesting facts which must be determined before we are on sure ground in regard to the use of any suitable pharmacological preparation. Only after a careful study of various lead preparations on animals will it be safe to apply them to human beings, and there must be strong reason for thinking that they are preferable to the original Blair Bell lead before they are used.

The future of lead therapy is still doubtful. That it is very dangerous goes without question, but I have treated some 70 human patients without a single death from the lead itself. Unfortunately most of them have died from the progress of their disease, though a few patients have had their tumors arrested, and Bell can show many more in Liverpool. Yet as the methods are still wholly experimental, we may have to wait many years before the final estimate of the procedure can be offered. Even in its present stage it remains the most important contribution to cancer therapy since the discovery of radiation.

LEAD THERAPY*

By LEILA CHARLTON KNOX, M.D.
NEW YORK CITY

ONE year ago, in June, 1928, a preliminary report was made† upon the treatment with solutions of colloidal lead of 60 patients with an established diagnosis of malignant disease. Many of these patients received deep roentgen therapy simultaneously. The report covered a period of two years of experience with the method. Twenty of the patients had received not over 150 mg. because a few days or weeks of observation showed that they were too ill, too cachetic or too much affected by the late complications of the tumors to justify any form of treatment other than alleviation of pain or discomfort. These 20 should, therefore, not be included in our series as they show nothing with regard to the effects of colloidal lead except that it should be reserved for patients with some physical reserve, some capacity to overlook discomforts and some ability to combat anemia and cachexia.

The other 40 patients were, for the most part, in advanced stages of the disease and presented recurrent or large primary tumors. Many had widespread metastases. All were considered hopeless. In general, the form of treatment indicated by Bell in 1925 was followed, and the results, while less curative, probably are to a large extent corroborative of his experience. The immediate results of the injections have been to produce a moderate amount of discomfort from anorexia, nausea, vomiting, chills with fever and, in a few cases, jaundice and general prostration. Sixteen of the 40 patients were given from one to four transfusions, to prevent or correct a fairly rapidly developing anemia. No serious nephritis, no neurological complications and no deaths have taken place as a result of the lead.

† Knox, Leila C. Lead therapy. *J. Am. M. Ass.*, 1929, *92*, 106–109.

Last year it was reported that 8 of the patients were living and 4 were clinically well. At the present time, July, 1929, five are living and 3 are in good health.

Case I of our earlier report, has developed new masses of tumor and although in fair general health, she cannot be expected to recover completely. Both roentgen therapy and lead have, however, always brought about improvement and both have been well tolerated. Her life and comfort have unquestionably been prolonged by the use of both these agents.

Case II. This patient has remained in perfect health. She has gained weight, undertaken many new activities and shows no possible indication of any tumor. She has had no subsequent doses of lead but several courses of roentgen treatments.

Case III. The patient is clinically well, but developed a peritoneal infection and at a subsequent laparotomy was found still to possess many peritoneal implants. He has had one more course of lead and of roentgen treatments, and is in better health than for three years. He is probably not cured.

Case IV. This patient is, two years and three months after beginning treatment, very well and shows no sign of tumor.

Since July, 1928, three additional patients have been treated, one with lymphosarcoma, late and widespread; one with a carcinoma of the thyroid recurrent for the third time, and one woman with a recurrent carcinoma of the cecum. Of these only the last has been improved. She is a young woman with no evidence of remote metastases and with good general health. She has been given 130 mg. of the Blair Bell colloid, and 270 mg. of the Lilly phosphate and now appears better than six months ago when the treatment was begun. Her tumor is of the same type as that described in Case III above.

It is, therefore, our impression that: (1) Colloidal lead has been, and will be,

* Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8–9, 1929.

effective in prolonging the lives of some patients with malignant disease.

(2) A rare but occasional permanent cure may be expected.

(3) In general, a patient should be relatively young, not anemic nor cachectic nor with extensive metastases in order to undertake the treatment.

(4) The morphology of the tumor is not a guide to the probability of its susceptibility to lead.

(5) The use of roentgen rays and lead have probably more effect upon the neoplasm than either of these used alone.

(6) The treatment is too prostrating and may be too hazardous to justify its use as a prophylactic measure.

(7) These results, as well as those of others who have used colloidal lead extensively, justify its use in a few carefully selected cases where adequate resources are available for meeting complications.

OBSERVATIONS ON LEAD THERAPY*

By H. J. ULLMANN, M.D.
SANTA BARBARA, CALIFORNIA

ANY statistical report that I might make on cancer treated with lead therapy would appear very discouraging. But I am still, after three years, using it as an adjunct to irradiation for those patients who, I believe, are beyond a reasonable hope of more than a temporary questionable palliation of their condition by any other known method. As we are ready to attempt treatment of any patient willing to stay in the hospital and submit to any procedure and test that we may prescribe, our percentage of failures, so far as ultimate results are concerned, is necessarily large. We find, however, sufficient effect on the tumors of these hopeless patients at autopsy to warrant continued study and have as encouragement several individuals who are apparently well from six months to two years.

Any physician who has neither experience nor a well-equipped institution in which to treat his patient is courting not only discouragement but trouble if he attempts the use of lead. I have found that nearly all of those using lead for the first time are afraid, and justifiably so, of a possible uncontrollable acute poisoning. They use small doses at frequent intervals and then complain of the anemia which follows. Lead will produce a prompt anemia in many patients when large doses are given, but this anemia usually disappears much more rapidly than the later one almost invariably following fractional dosage. I have also found that the smaller doses produce less effect on the tumors than the large ones even when the same amount of lead is given over the same total time. We have never been able to demonstrate kidney injury from use of our lead phosphate, either clinically or at autopsy. There is, however, a constant liver damage which is not demonstrable clinically unless the greater part of the organ has been replaced by tumor. The damage consists of fatty change and recovery is apparently prompt.

An annoying symptom is the occasional chill following the injections. This is due to gelatin, a necessary ingredient of the colloidal solution. It is harmless but the patient is apt to be frightened unless prepared. We have observed one violent shock. This occurred in a patient who had had intramuscular injections of the solution and quite evidently had been sensitized. The patient went into shock during the injection. It was severe and required intravenous use of adrenalin. Chills usually occur one to two hours following the injection. These chills may appear after any one or all injections in any one patient, though some patients never have them. There may be an accompanying rise of temperature varying from 99 to 103° F. No treatment is required except hot water bags and blankets for the severe types.

Pain in the tumor is usually complained of from three to five days after the injection and if not felt to some degree we consider the prognosis is bad.

The longer we use lead, the stronger the impression grows that our results have been better where a thorough course of irradiation has been given prior to the lead. We now make a practice of giving a preliminary irradiation unless this has been given previously. Irradiation is again used after and sometimes during the course of lead injections.

Patients with very large tumor masses always do badly. As the tumors begin to regress a toxemia develops much like

* From the Department of Cancer Research Santa Barbara Cottage Hospital, Santa Barbara, Calif. Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8–9, 1929.

that seen in sensitive lymphosarcomata following a full dose of radiation. At the first sign of this toxemia all treatment is stopped, either lead or irradiation, and is not resumed until all symptoms disappear. This may be two weeks or more and usually lasts as long as the tumors are regressing. I have found that alkalinization, with or without glucose by vein or rectum, and salt by hypodermoclysis, is usually all that is required in the way of active therapy for the toxemia either of lead itself or from tumor absorption. Calcium may be given by mouth in addition to any of these if symptoms of lead colic occur.

One of our most important problems has been to determine what compound or compounds were formed by lead with the blood. If we could determine this it might assist us in finding either a less toxic compound, a more efficient one, or both. Bischoff and Maxwell* have shown that lead combines with blood serum to form a double phosphate of calcium and lead. This has about the same toxicity as the orthophosphate. They discovered, however, that this was not the reaction with the red cells. The compound formed by the interaction of lead and erythrocytes is a lead phosphoglycerate. It is as toxic as ionic lead, perhaps more so. One-fourth of ionic lead added to blood goes to this compound. Tests with it are being made on cancer rats. A full report of this chemical study will be reported at the International Physiological Congress at Boston in August by Dr. Bischoff.

* Bischoff, Fritz, and Maxwell, L. C. The precipitation of blood calcium by lead. *J. Biol. Chem.*, 1928, *79*, 5–17.

LIPOMA OF THE COLON

REPORT OF TWO CASES*

By WILLIAM H. STEWART, M.D., *and* H. EARL ILLICK, M.D.
NEW YORK CITY

IN THE interpretation of roentgenograms of the gastrointestinal tract, diagnosis of the exact pathology present may be difficult or even impossible since strikingly similar shadows may be obtained from several very different lesions.

The first case presented herewith was one in which a routine barium clysma following the barium meal was given to exclude disease of the colon, and a benign neoplasm was found.

CASE 1. The patient, a female, single, aged forty, was admitted to Lenox Hill Hospital on Jan. 21, 1929.

Past History. Irrelevant.

Present History. Since an attack of influenza nine years ago she has had considerable belching, occasionally accompanied by epigastric pain which the belching relieved. She has become markedly constipated and has frequently noticed slime in the stools, but never fresh blood; they are never tarry, are occasionally grayish. On three occasions she has had jaundice.

Five weeks ago, during a menstrual period, she had a severe attack of pain beginning in the left lower quadrant and radiating all over the abdomen and down the inner side of the thigh. She had a second attack a week later, which was not so severe as the first. For two weeks she felt uncomfortable in the abdomen, belched continually and had no appetite.

Two weeks ago she had a similar attack lasting ten days, being worse after eating. She vomited twice. The pain which was so severe that she could not sleep, radiated to the shoulder blades. No jaundice. Constipation, belching, slime in the stools continued. For the past week she has been on a milk diet. For the past three days she has had no pain except for two hours on the night before admission when she had pain in the left lower quadrant radiating all over the abdomen and to the shoulder blades. Her weight four months ago was 150, it is now 140 pounds.

Physical Examination. The patient did not appear ill. Abdomen soft; no masses, no sensitiveness. Blood count: red blood cells, 4,340,000; white blood cells, 6,900; hemoglobin, 66 per cent.

Roentgen Examination. The Graham test was done. No gallstones were demonstrated. There was a normal cholecystographic response to the oral administration of the dye. There was slight ptosis of the stomach. There was no roentgen evidence of ulcer or cancer. The stomach was empty at six hours. At twenty-four hours the meal was in the ascending colon and proximal third of the transverse colon where there was an apparent delay. The routine barium enema caused marked distress.

FIG. 1. Case 1. Roentgenogram after barium enema showing filling defect in the transverse colon, indicating lipoma.

* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

Fig. 2. Case I. Confirmatory barium enema in which the lipoma blocked the transverse colon, preventing the opaque material from reaching the proximal colon.

There was considerable spasm of the colon and a filling defect in the transverse colon was noted (Fig. 1). A second barium enema filled only the lower half of the colon, meeting complete obstruction in the midtransverse portion. Although the lower colon was distended, no barium passed through this area. The obstruction resembled a deformity from a mass inside the lumen of the colon (Fig. 2).

The provisional preoperative diagnosis made by Dr. DeWitt Stetten of the Surgical Service was pedunculated benign tumor, probably submucous lipoma, of the transverse colon with recurrent attacks of intussusception.

Operative Findings, Feb. 7, 1929. Just to the right of the midportion of the transverse colon is a smooth, firm, freely movable, ovoid, pedunculated tumor the size of a large egg attached by a somewhat broad pedicle to the interior of the lower posterior wall. There is considerable infiltration around the base and numerous hard, enlarged lymph glands can be felt in the adjacent mesentery. The tumor has the characteristic feel of a benign growth. The mucous membrane over the apical half is gangrenous. On section the tumor is found to be a rather firm, fatty growth typical of a submucous lipoma.

Final Diagnosis. Pedunculated submucous lipoma to the right of the midportion of the transverse colon with recurrent attacks of intussusception.

In the second case a lipoma of the colon was accompanied by a separate cancer in another portion of the colon.

Case II. The patient, a male, aged forty-five, came to the hospital complaining of constipation, pain in the lower abdomen and belching of gas. Two weeks previously, after a heavy meal, the patient took magnesia, following which he vomited but had no bowel movement. Two days later his local doctor advised an enema which gave some relief. He had a few small bowel movements later. He ate only sparingly; had no vomiting, no ribbon-like stools and no loss of weight. Two days before admittance he again began to vomit but had no satisfactory bowel movements.

On admission to the hospital his physical examination revealed an abdomen which was flat with no visible peristalsis. There was rigidity. Slight tenderness was noted on pressure.

Fig. 3. Case II. Showing the lipoma in the pelvic colon and the cancer in the first portion of the descending colon.

Roentgen examination showed a marked obstructive lesion at the splenic flexure, the character of the shadows strongly suggesting a malignant growth. In the pelvic colon there was a filling defect which was similar to that seen in a case of lipoma (Fig. 3).

Operative Findings. There was a normal amount of free fluid in the peritoneal cavity. An annular carcinoma was found encircling the colon at the splenic flexure and was removed. About the middle of the sigmoid a pedunculated, soft mass was felt which was attached to the posteromedial surface of the mucous membrane within the lumen of the colon. On palpation the surgeon was of the opinion that it was a lipoma.

In conclusion, it may be stated that lipomata of the gastrointestinal tract occur most frequently between the ages of forty and sixty or, in other words, at the cancer age. In the colon, cancer is the most frequent malignant tumor, while adenomatous polyps are the most common benign tumors. Lipomata occur next in frequency to polyps. Lipomata are usually single but may be multiple. They are rounded or ovoid and attached to the gut by a pedicle. They arise from fat in the submucous layer of the intestine and grow inward into the lumen. They may never produce symptoms. They may occur anywhere in the alimentary tract, various pathologists finding different portions involved. The stomach, ileum and rectum appear to be favorite sites.

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EDITORIAL

THE DRIFT IN HOSPITAL ROENTGENOLOGY

AT THE recent meeting of the American Roentgen Ray Society in New York City an opportunity was given to members to inspect the roentgen-ray departments of several of the newer hospitals. We found ourselves interested not so much in the types of apparatus and technique of procedure as in tendencies and changes in roentgenologic practice.

The tendency was not the organization of one or more large central plants with perfect adaptation of space and apparatus to the diversities of roentgen work and the simultaneous employment of numerous technicians; instead we found many small separate installments, each complete, as items of the equipment of various departments of medicine, surgery, pediatrics, genitourinary, skin, orthopedic, and so forth, making in one hospital, so we were told, fourteen separate roentgen-ray installments under separate heads. These heads were the professors of the departments.

Is this decentralization a necessary process in the better adaptation of roentgen-ray work to the needs of the various departments of medicine and surgery? Is the distinction between roentgenologist and technician disappearing in hospital practice? And with the passing of those older roentgenologists whose achievements and reputation have withstood the rising tide of abundant technicians, will roentgenology survive as an independent department on a par with other specialties in medicine?

No pessimism is intended. It is right that roentgenology should find its own permanent footing. Such a footing seemed to have been assured with the establishment of full professorships in roentgenology. But curiously enough this step has helped the decentralization process. Adequate instruction in the meaning and interpretation of roentgenograms has become a necessary and most commendable part of medical education. Outside of our schools, roentgenologists and technicians are also familiarizing practitioners with all phases of roentgenology. The dissemination of useful knowledge is always good. As a result, however, the medical graduate, while he needs the hospital technicians to produce his films, feels more and more competent to read them himself.

In certain ways he may be in a better position to interpret the films than the roentgenologist. It is he who has the history of the case, has made the physical examination of the patient and is in possession of the laboratory data. What is the roentgenologist to do in a busy small hospital where he does most of the technical work outside of the dark room? Or what is he to do in a large hospital where a stack of films, day after day, awaits his examination and report? Is it possible for him to consider the details of each case in connection with the films to be examined? Most roentgenologists would say, "Theoretically right, practically impossible, mostly unnecessary."

In regard to fractures, dislocations, foreign bodies and a certain proportion of other cases this is true, but in regard to internal disease the question is being answered in a way that deserves our attention.

This drift is seen in roentgenologic literature which shows that the movement began long ago. Braasch has written two of the best works on the interpretation of roentgen findings in cystoscopic examinations,

but Braasch is not a roentgenologist. Scudder's work is one of the best on the roentgen examination of fractures but no one thinks of Scudder as a roentgenologist. Rotch's book on the interpretation of roentgen findings in childhood has remained an authoritative work, although Rotch was a professor of pediatrics. Volume III of the Annals of Roentgenology on the "Digestive Disturbances of Childhood" is by Kerley and LeWald. The fact that Kerley who is not a roentgenologist is yet the leading author is suggestive of the dominance of the clinical side in roentgen interpretation. Likewise Volume VII, of this same series, on "Urological Roentgenology" by Young and Waters is another striking example of the superior position which the specialist occupies in roentgen interpretations within his chosen field. One of the greatest works yet written on the roentgenology of "The Heart and Aorta" is by Vaquez and Bordet, and yet Vaquez, as is known, is Professor à grégé à la Facculte de Médecine de l'Hôpital Saint-Antoine. Graham revolutionized the roentgen examination of the gall-bladder, and Graham's work is the fountain source of the interpretation of roentgen findings of the biliary tract. Yet, needless to say, Graham is not a roentgenologist.

This list could be extended and could be greatly amplified by references also to roentgenological material in medical and surgical journals. But enough has been stated to emphasize the point that the internist, surgeon or specialist who becomes an interpreter of roentgen findings often becomes a highly competent roentgenologist and that the roentgenologist who ceases to be a general diagnostician becomes a technician.

Thus the roentgenologist has a competition of a most useful kind. He must exert himself to maintain his status. He must know more than the internist, the surgeon, the urologist or any other specialist, about the diagnosis of disease. He cannot limit himself to those diseases or conditions which are now the subjects of roentgen examination because of the wide necessities of differential diagnosis, because of the interdependence of body organs and, finally, because roentgenology is a progressive science. He must take all pathology as his province because roentgenologic research is mostly the translation of pathological conditions into terms of roentgenology.

This conception of the job which faces the roentgenologist is the one which requires him to be a general diagnostician with the sky as the limit of skill and learning. That the best type of roentgenologists are already rising to this level is shown by the programs of our national societies where the titles of papers read refer to diagnostic and clinical problems rather than to roentgenologic methods. For example, "Massive Collapse of the Lung," "Gastric Hemorrhage," "Chronic Lung Suppuration," "Cecal Stasis," "Bone Lesions of Congenital Syphilis," and so on.

We thus see the drift of society work towards the highest type of roentgenology and the drift of hospital work towards a type with the roentgenologist omitted. Numerous exceptions do not change the main line of the current. To strengthen our societies is to conserve the best interests of roentgenology which are identical with the best interests of patients and of the medical profession. Perhaps some day we may be masters of our own domain.

A. W. Crane

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-first annual meeting: West Baden, Indiana, Sept. 23–26, 1930.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual Meeting, Detroit, Mich., 1930.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting, Detroit, Mich., June 23–27, 1930.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.
Sixteenth annual session: 1930, to be announced.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, Fisher Building.
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Robert E. Pound, Fifth Avenue Hospital.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.

Secretary, Dr. James M. Flynn, 282 Alexander St.

Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB

Secretary-Treasurer, Dr. L. R. Sante, Missouri Building

Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.

Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY

Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.

Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB

Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY

Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.

Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)

Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.

Secretary for German language, Dr. Scheurer, Molzgasse, Biel.

Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GE SELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖENTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. O. Wissing, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

ROENTGEN-RAY STANDARDIZATION

THE Bureau of Standards, now being in a position to begin its program of roentgen-ray standardization, is anxious to inform the medical profession in order that they may avail themselves of this service.

Accordingly there follows the proposed program which has been received from Dr. George K. Burgess, director of the Bureau of Standards at Washington, D. C.

I.

The solution of the problems of roentgen-ray standardization has arrived at a point where the Bureau of Standards is in a position to calibrate ionometers for the public.

The discrepancies between different standardizing laboratories in regard to the magnitude of the r-unit are now small enough to be neglected in connection with medical applications. The basis for this conclusion is the agreement within 2 per cent, recently obtained by a comparison, through the cooperation of Dr. Glasser, of two instruments from the Cleveland Clinic with those used by the Bureau; and the fair agreement found earlier between the Cleveland Clinic instruments and those of the Reichsanstalt of Germany. Further comparisons will of course be made between the different national laboratories.

II.

An ionometer sent to the Bureau may be calibrated for any condition of voltage and filtration desired although all such instruments, to be accepted for calibration, must be adequately controlled by such means as radium or uranium oxide. This will minimize the possibility of undetected damage occurring to the ionometers in transit.

The following procedure is necessary to avoid delays and complication: notify the Bureau as far as possible in advance of the shipment of the instrument, giving at the same time the type of instrument, date of purchase, method of controlling its calibration, type of x-ray machine with which

it is used, peak voltage applied to the x-ray tube as actually measured with a sphere-gap and the half-value layer in copper or the effective wave length of the radiation with an explanation of how the measurement was made.

III.

If the ionometer has been previously calibrated a copy of the calibration should be supplied in order to complete the Bureau's records for every instrument it handles.

The cost of this service will depend upon the number of calibrations made for each instrument. A schedule of fees may be had upon request after sending in the information required above in addition to stating the number of calibrations desired.

NOTE ON PYELOURETEROGRAPHIC INTERPRETATION

To the Editor:

Pyeloureterographic interpretation has been passing rapidly into the hands of the well-trained urologist. It is necessary that the urologist pass the catheter and inject the opaque media. He is in possession of the urine analysis, the functional tests, and has before him the observation of the cystoscopic field. These factors are his in addition to the pyeloureterogram. Also, as a specialist dealing with the genitourinary organs only, he is well versed in general genitourinary problems confronting him.

There are occasions, however, when a general knowledge of roentgenology and its various problems may be of assistance to the urologist in his interpretation of a pyeloureterogram.

Figures 1 and 2 illustrate a single example of a pitfall believed to be a common one for the unwary urologist. Figure 1 represents a film of a patient after he has taken a deep breath and held it. Figure 2 is of the same patient after expelling the air from his lungs and holding his breath.

The patient was a fairly thick-set individual. He was lying on his back at the time the films were made. A compression band was used. No ptosis of the abdominal viscera existed. It is obvious that the kink in the ureter was caused by the patient holding his breath at inspiration.

George U. Pillmore

Fig. 1. Inspiration.

Fig. 2. Expiration.

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

A VISUAL WARNING SAFETY DEVICE FOR THE ROENTGENOSCOPIC ROOM

By FRANCIS W. BISHOP

School of Medicine and Dentistry, University of Rochester

ROCHESTER, NEW YORK

WE HAVE developed a simple device which gives visual warning when safe roentgenoscopic current has been exceeded. The roentgen generator of today is almost silent in operation, yet it is powerful enough to possess potentialities which should inspire a wholesome respect. In contrast to other machinery, roentgen apparatus has few safety devices connected with it.

Most roentgen-ray apparatus has a double-scale milliammeter either on the control board or in the high tension system. Herein lies a possibility for accidents. The writer knows of at least four definite instances where roentgenoscopy has been performed with the milliammeter switch thrown on the high scale. The operator was using, instead of the customary 3 to 5 milliamperes, some 30 to 50 milliamperes. In each case, the tube target was melted, heavy dosage was given to the patient, as well as an excessive exposure to the operator. It would seem that the more powerful roentgenoscopic light should warn the operator, but since there is usually a great voltage drop with the increased load, this observation may to some extent be obscured. At such times, there is a large amount of soft radiation generated which is easily absorbed by the skin of the patient to that individual's detriment. The change in sound of the machine under the increased load is not always a warning, for in two such cases, the outfit, mechanically rectified, was installed in the roentgenoscopic room itself so that the change in sound should have been noted. Many machines either mechanically rectified, valve tube rectified, or self rectified, are installed in an adjacent room so that in these cases the sound changes which occur with load are not so easily observed. It is seen, therefore, that this accident may occur even under the best conditions. Furthermore, due to line conditions or to changes in the machines, the milliamperage may creep up or down during an examination.

The device about to be described does not interfere with the operation of the machine for roentgenographic or other

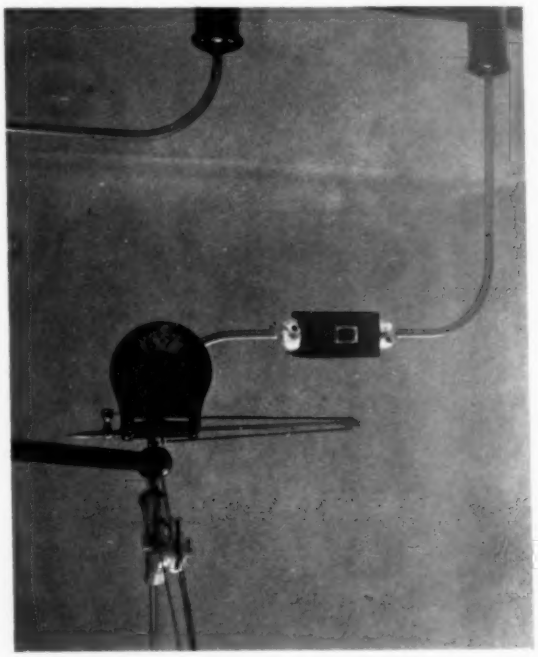

Fig. 1. Safety device mounted in overhead system. Window for viewing lamp is outlined in white.

work, nor does it require any attention after installation. There are no moving parts. It may be of two types, one for mounting on the control board of the machine and one for installation in a conspicuous place in the overhead system (Fig. 1).

It consists of three essential parts, a neon lamp, a resistor, and a small condenser. The neon lamp used is a tubular affair about one inch in length over-all and one-half inch in diameter. Metal caps are sealed over the ends for contact purposes. There are small wire electrodes sealed in the tube between which the discharges pass. The lamp contains besides neon gas, a small quantity of other gases which give the tubes the characteristic of a practically constant voltage drop regardless of the current. This is an important factor as it practically decides the kind of resistor used. The potential required to operate the lamp is approximately 90 volts. This voltage is obtained from the high tension circuit by utilizing the voltage drop through a suitable series resistor. A drop of 90 volts in the high tension system is, of course, negligible. The value of the resistor, which would produce a voltage drop of 90 volts with a current of 5 ma. flowing through it, is approximately 16,000 ohms. At this value of current, the power consumed in the resistor is less than one-half of a watt. At 100 ma., were it not for the fact that the neon lamp, due to the characteristic before mentioned, carries practically all of the current, there would be a voltage drop in the resistor of 1,600 volts and an expended power of some 160 watts, more, of course, than can be safely carried in a small resistor. Since the power consumed in our resistor is never more than one-half watt, common radio grid leak resistors of the proper value can be used. If other types of neon lamps are used, care must be taken to see that a resistor of ample current-carrying capacity is chosen in addition to the proper resistance value. The neon tube is connected in multiple with the resistor (Fig. 5). Many roentgen-ray machines, depending of course upon the method of rectification, etc., produce a considerable amount of high frequency current. It is necessary to prevent this current from reaching the neon tube. A suitable condenser is shunted across the lamp and resistor to act as a by-pass. Since the voltage drop is very low, fixed condensers such as used in radio work can be employed. A value of 0.25 microfarads is ample. The lamp and resistor can be placed in a standard radio grid leak mounting and, with the condenser, can be mounted in a suitable tubing to which caps embodying proper fittings for insertion in the overhead system are attached. The caps are insulated by fiber bushings, and the leads from the neon lamp, resistor and condenser are attached. A slot is cut in the tubing to allow the glow of the lamp to be visible (Fig. 2). The device is plugged into the high tension system in the same manner as a coupling, in such a position as to be visible to the operator. Polarity has a slight effect on the brilliancy of the glow so that a trial should be made for best results. The instrument should be plugged in some part of the overhead tubing which is not carrying filament current and preferably on the roentgen tube side of the spark gap. It is left permanently in circuit. During roent-

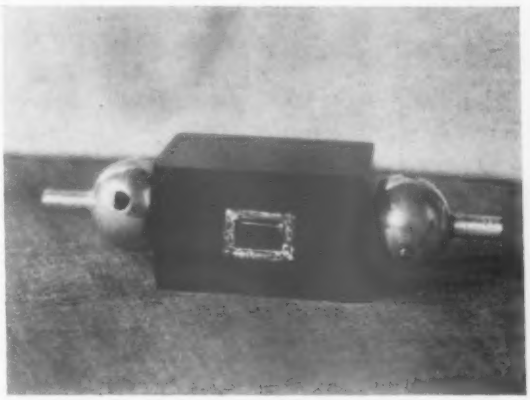

Fig. 2. Overhead safety device removed. Neon tube is visible in the interior.

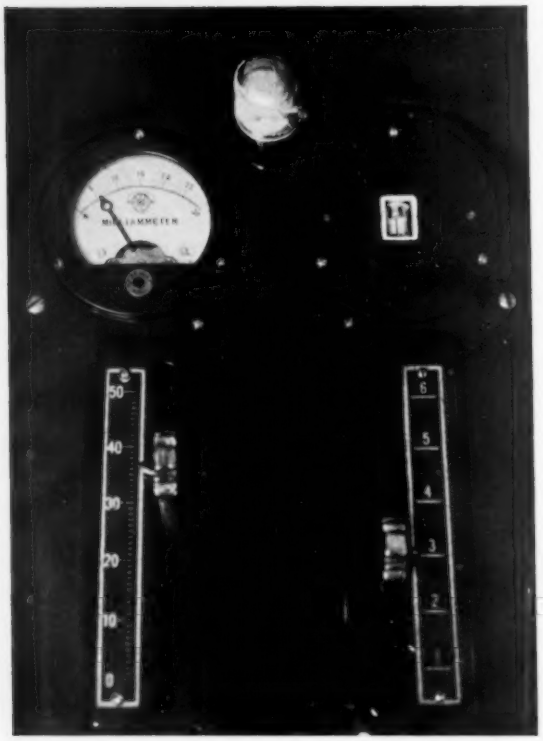

Fig. 3. This view shows the arrangement of the neon lamp on a roentgenoscopic control board. The lamp is shown glowing at 5.5 ma.

genoscopy, up to any predetermined current as determined by the value of the resistor, the neon lamp does not light. If this current is even slightly exceeded, the lamp glows with the characteristic red color of neon-filled lamps. This light is the warning to the operator that he is exceeding the safe current. During the roentgenographic exposures at high currents, the tube simply glows. It has no filament to burn out and should last indefinitely.

The same device is capable of being mounted upon the control boards of those machines which employ the center tapped high-tension transformer with the milliammeter mounted on the board (Fig. 3). It can be placed anywhere convenient and can be connected in series with the control board milliammeter. A small discarded meter case makes an excellent container for the instrument. A small window should be provided for visualizing the lamp (Fig. 4). The device has the same characteristics when used on the control board as when used in the higher potential points in the high tension system. The device may be used on any machine, regardless of the type of rectification, to indicate when a certain roentgen tube current has been exceeded. This indicator can be applied also for roentgenography or therapy. Its action is entirely independent of the kilovoltage applied to the roentgen tube.

If more than a visual warning is desired, a sensitive relay may be connected in the neon lamp circuit to operate an electric bell or other device (Fig. 5). This is applicable, of course, only to the switchboard instrument.

CONCLUSION

A safety device incorporating a neon lamp, a resistor, and condenser has been described which will automatically indicate when a predetermined roentgen-ray tube current has been exceeded. It requires no attention after installation and does not interfere with the use of the roentgen machine for any purpose that may be desired. It requires only a small charge to function and does not alter the settings of the machine. It gives sufficient light to be visible at all times when the critical current

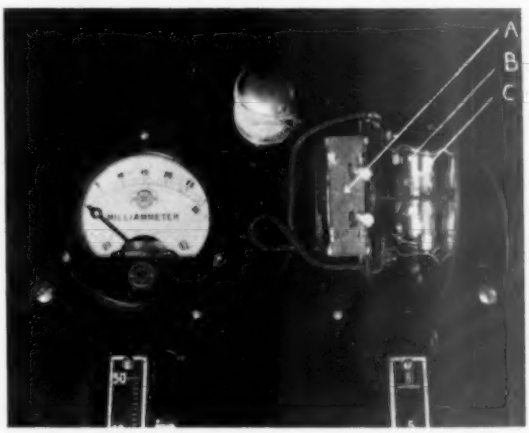

Fig. 4. Safety device removed from board. A. Condenser. B. Neon tube. C. Resistor (grid leak).

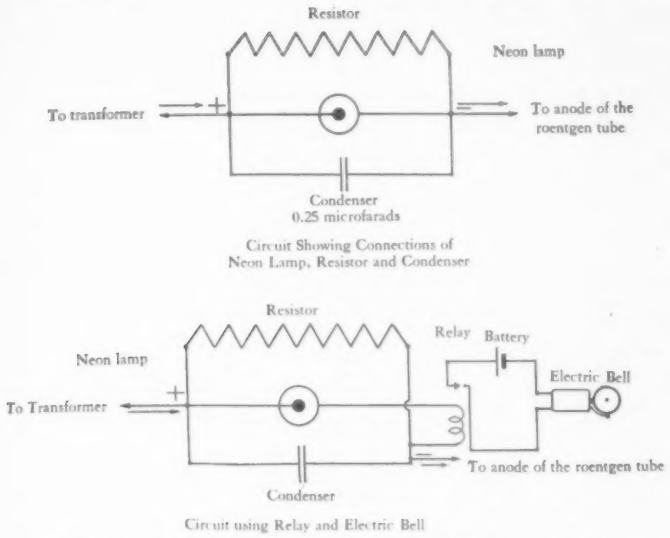

FIG. 5. Fundamental circuits of the safety device.

has been exceeded but does not glow when safe currents are being used. It will, therefore, warn the operator that he is exceeding a safe setting, and thus prevent destruction of the roentgen tube as well as excessive exposure to the patient and himself during roentgenoscopy. A variation of the device has also been mentioned which gives audible warning when a predetermined current has been exceeded.*

* The neon lamps were obtained from the Engineering Products Corporation of Boston, Massachusetts, while all other parts are standard to the radio industry.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE TREATMENT OF THE COMMON DISORDERS OF DIGESTION: A HANDBOOK FOR PHYSICIANS AND STUDENTS. By John L. Kantor, Ph. D., M.D. Visiting Physician in Gastrointestinal Diseases, Vanderbilt Clinic, Presbyterian Hospital; Associate in Medicine, Columbia University, etc. Second edition. Cloth. Price, $6.00. Pp. 300, with 88 illustrations. St. Louis: The C. V. Mosby Co., 1929.

As the title indicates, the book deals almost entirely with treatment. When it seems desirable to do so, only so much of the context is given over to the presentation of features other than therapeutic measures as is necessary for the proper grouping of the disorders of digestion. The majority of the illustrations are very satisfactory roentgen appearances of the common gastrointestinal conditions. This work is written in a style that is pleasing and easily readable.

The first edition appeared in 1924. In the second edition important material has been added, but there is no significant change in the material originally presented in the first edition. Greater emphasis is laid on disorders of the colon in the revised edition. In the revision the author has found it desirable to rearrange the sequence of some of the chapters, and in certain instances parts of the original manuscript are in different or new chapters. Three chapters and twenty-nine illustrations have been added.

Many helpful suggestions are given in the chapters dealing with general principles and methods, the management of functional digestive disorders, and the treatment of ptosis and the asthenic state. Under the treatment of the syndrome of "gastric irritation" two new paragraphs refer to the use of the neutral antacids. Two chapters are given to the treatment of gastric and duodenal ulcer; additional sections mention modifications of the Sippy regimen and sound advice about the "after treatment" of cases in which surgery has been employed. The management of "delayed gastric emptying" occupies a chapter, as also does the treatment of gall-bladder disease. The manuscript on these subjects in the new edition is essentially unchanged. The important addition to the subject of achylia gastrica (achlorhydria) consists of a classification of achlorhydria in the section on "definition and differential diagnosis," and a new section on diet in pernicious anemia. The "redundant colon" and the "low cecum" are discussed under a new chapter heading of "Treatment of Common Anomalies of the Colon." The redundant colon was included in one of the chapters on constipation in the first edition. A comprehensive consideration of constipation is given in three chapters. There is little change in the subject matter in the two editions. In this edition the subject of mucous colitis is placed in the new and useful chapter on the irritable colon. In the three chapters (two in first edition) on treatment of diarrheas there is a slight rearrangement of the classification and new material on ulcerative colitis is added. The possible significance of vitamines in ulcerative colitis is mentioned. The final chapter discusses the treatment of headaches associated with indigestion.

Serviceable working plans of management of digestive disorders are given concisely. These plans can be modified readily to suit the individual case, and the importance of individualization in therapy of gastrointestinal conditions is emphasized. The simplicity of the principles of the use of diets in treating digestive disorders is pleasing. This book fulfills a very definite need and should be particularly valuable to the practitioner.

CHARLES L. BROWN

PHYSIKALISCH-TECHNISCHES PRAKTIKUM FÜR MEDIZINER. EINE EINFÜHRUNG IN DIE ANWENDUNG VON MESSMETHODEN UND APPARATUREN. (Manual of Physics for Physicians. An Introduction to the Application of Measuring Methods and Apparatus.) By Dr. Phil. Alfred Krethlow, Ehem. I. Assistant am physikalischen Institut der Universität Basel. Paper. Price, RM 15.60. Pp. 232, with 127 illustrations. Berlin: Julius Springer, 1930.

Nowadays, the training of physicians in physics lags far behind its increasing impor-

tance in therapy and diagnosis. There is a twofold reason for this. In the first place there is lack of time in the medical curriculum; and secondly, the usual adequate courses in physics are designed primarily for students specializing in the natural sciences. It is, of course, well known to teachers in the preclinical sciences that many medical students are woefully wanting in more than the merest rudiments of physics and chemistry. The results are obvious. Such physicians, when required to employ the now common physical methods in diagnosis or therapy, apply them improperly, or else they are forced to ignore them, or refer their patients to specialists.

How this situation can best be met remains still to be determined. An effort in this direction is this manual by Dr. Krethlow designed for the student of medicine. In its favor is the claim that it has successfully met the needs of physiologists, clinicians and internists trained in the medical school of Basel.

The manual under review is written in German and the references quoted are mostly up-to-date, but they are almost entirely to the German literature. The work is divided into eight main divisions: (1) Weighing; (2) Optics; (3) Electricity; (4) Radioactivity; (5) Hemodynamics; (6) Electrocardiography; (7) Analysis of heart sounds and respiratory murmurs; (8) Electrical fields of physiological origin.

A large portion of the manual is devoted to the theory and medical applications of roentgen rays. The subjects of diathermy and radioactivity are also included.

The discussions in this small introductory work are necessarily brief but they are lucid and usually accompanied by illustrative problems which are worked out in detail.

The author has in this manual of physical methods a most worthwhile beginning and subsequent revisions will undoubtedly include many more methods and applications in medicine. It occurs to the reviewer that the inclusion of brief discussions of colorimetry and nephelometry and of the hydrion and quinhydrone electrodes would be of value.

B. Cohen

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Head

Kern, Richard A., and Schenck, Harry P. The relative efficiency of the clinical and the roentgenologic methods for sinus disease diagnosis. *Am. J. M. Sc.*, August, 1929, *178*, 168–190.

This is a study of paranasal sinus disease in 200 asthmatics in which a comparison is made between the relative efficiency of roentgenologic and clinical examination. The method of conducting this study is outlined. The essential features in the clinical examination and the roentgenological technique are described.

Sinus disease was reported in 80.5 per cent of the 200 asthmatics by roentgen examination, while the clinical examination revealed 67 per cent positive findings. There was complete disagreement between the clinical and roentgenologic findings in 25 per cent of the patients.

In order to check on the accuracy of the two methods, operations were performed on as many positive cases as possible. Eighty-six of the 200 cases submitted to operation. No case of frontal sinus disease came to operation. In the ethmoid group the roentgen-ray error was 14.3 per cent while the clinical error was 24.3 per cent. In sphenoid sinus disease the roentgen-ray error was 10 per cent, the clinical error, 30 per cent. In maxillary sinus diagnosis the roentgen-ray error was 48.2 per cent, while the clinical error was 43.6 per cent.

Thus while neither method of examination was very accurate, the roentgenological examination was somewhat more sensitive than the clinical, especially in the study of the ethmoidal and sphenoidal sinuses.

In order to determine the relative frequency of sinus disease in asthmatics as compared with normal individuals 50 patients in whom there was no history of recent respiratory infections or past history of sinus disease were examined by the two methods. Neither the roentgenologist nor the otolaryngologist had any knowledge that patients were in the so-called normal group. In these 50 patients 72 per cent were reported as having sinus involvement by the roentgen examination while the clinical incidence was 26 per cent. Thus it is seen that by roentgen examination the incidence of sinus disease was almost the same in the normals as in the asthmatics. Operative check, of course, was not possible in the control group.

The high incidence of sinus disease as revealed by roentgen-ray examination is due to the fact that both past and present disease can be detected. The clinical examination, on the other hand, most frequently detected only active disease. A positive roentgen finding does not imply clinically active disease. As a matter of fact, this method will often overlook acute sinus infection. The authors do not believe that the roentgenologist's interpretation of sinus disease in terms of pathologic changes such as thickened mucous membrane, polyps, etc., is justifiable inasmuch as such diagnoses are not infrequently erroneous. The clinical examination frequently overlooks chronic disease. Transillumination findings were shown to be quite frequently fallacious.

The conclusions arrived at are that neither method of examination can be relied upon alone but that both methods are required in the study of patients suspected of having sinus disease. In chronic cases a positive report by either method does not necessarily imply active disease. A positive finding by either method in an asthmatic is an indication for the opening of the affected sinus. The study would indicate that sinus disease is quite prevalent in the part of the country where the study was made. The age of the patients studied did not appear to be a material factor in the incidence of sinus disease.—*Karl Kornblum.*

Lindblom, A. F. Sinusitis Highmori Calcificans. (Calcifying inflammation of the antrum of Highmore.) *Acta radiol.*, 1929, *10*, 210–218.

Three cases of calcareous inflammation of the antrum of Highmore are described, in all of which roentgen examination was made and operation performed later. Careful histological examinations were made of the calcified tissue and the lining membrane of the antrum. Thirteen similar cases have been described before.

In cases in which there have been no foreign bodies the cause of the calcareous process has not yet been fully determined. It is probable that the formation of granulation tissue plays an important part in causing the calcification. If this is true the name of granuloma calcificans would seem to be the best one for the condition. It is not probable that either the age of the patient or the duration of the sinusitis has anything particular to do with the development of the calcification. The author also discusses the location of the calcifications and the differential diagnosis from osteoma. No descriptions have ever been given of similar independent calcifications in adjacent cavities.—*A. G. Morgan.*

Neck and Chest

Bartelink, D. L. Stereography of the chest. *Acta radiol.*, 1929, *10*, 167–172.

The present method of making stereoroentgenograms is criticized because it does not take into consideration the movements of the heart. The movements of the heart cause parts of the heart to be seen in front of or behind their true position, or even outside the chest when looked at stereoscopically. The author describes a simple device which makes the two exposures coincide with two separate diastoles, a couple of seconds after each other, in such a way that the heart is in the same position when the two exposures are made. Making the exposures during diastole also has the advantage that the exposure can be quite long without the heart shadow losing its sharpness.—*A. G. Morgan.*

Casellas, P. R. A roentgenologic study of the child's chest. *Radiology*, May, 1929, *12*, 382–385.

The author deals with the most frequent problems encountered in the child's chest, in the solution of which roentgenology plays an important rôle. He believes that, generally speaking, roentgenology in childhood is as dependent on clinical evidence as pediatrics is on the mother of the little patient, and that the referring physician makes an intelligent examination possible, at times, only by giving to the roentgenologist full information about the case.

When thymic enlargement is suspected, the author makes three exposures, one in the upright position, one in the prone, with the patient quiet, and the third in the same position while the patient is crying—all flashed at the end of expiration. A frankly enlarged thymus will register in all three positions. The shadow cast by a pathologic thymus is less dense than the one seen in cases of mediastinal adenitis; it usually projects from both sides of the median shadow, though it may be unilateral; its borders are clean-cut and convex, and its widest point is where it merges with the heart shadow. The shadow widens considerably from the film taken in the upright position to that taken in the prone position with the patient crying. In miliary tuberculosis in children the tubercles in myriads are reproduced on the roentgen film as hyperdense areas surrounded by a fine, blurred, less dense ring which is cast by exudative material. Pulmonary gummatous parenchymal infiltration may have a miliary distribution, but the shadows are larger and the blurred ring is missing, due to lack of exudative reaction around the individual gumma. Bronchopneumonia and lobar pneumonia give such characteristic roentgen appearances that their detection in conjunction with the clinical symptomatology does not require great acumen. Pulmonary tuberculosis is always secondary to mediastinal glandular infection, and fan-like shadows, with the base toward the periphery, are seen radiating into the pulmonary field from the region of the hilus, most frequently into the upper lobes. All the cases observed by the author have been unilateral. Subacute mediastinal adenitis is shown on the roentgenogram as dense bilateral shadows, with irregular concave borders, found in the posterior mediastinum. In acute mediastinal adenitis the roentgen findings are rather typical, one of the shadows of the hilus seeming greatly increased in size and so dense as to have a consolidated appearance. If the disease reaches the terminal stage, breaking down of the glangular structures takes place, with subsequent abscess formation. These mediastinal abscesses are demonstrated roentgenographically in the form of a triangular dense shadow directly behind the heart, with the base close to the diaphragm and the apex at a level with the region of the hilus. Acute mediastinitis shows in a roentgenogram as a well-demarcated area of hyperdensity, projecting from the median shadow into the left side, overlapping the structures of the hilus.—*J. D. Camp.*

Hennell, Herman. Massive pulmonary atelectasis (collapse); its probable mechanism and clinical significance. *Arch. Int. Med.*, October, 1929, *44*, 604–620.

A consideration of the probable mechanism of massive pulmonary atelectasis (collapse) is dealt with in this paper. From the author's experience and a review of the literature, all cases of massive pulmonary atelectasis are classified into three groups:

Group 1. Cases with gross or manifest bronchial obstruction by foreign body, endobronchial neoplasm, retained blood clots, diphtheritic membrane.

Group 2. Cases in which the primary factor is an interference with the respiratory movements, through muscular paresis or paralysis, voluntary or reflex inhibition of the muscles of the respiration from pain or inflammation; prolonged faulty posture, etc. When this is associated with an increase in the bronchial secretions and a suppression of the cough reflex, the accumulated and retained secretions will occlude the bronchi and thus lead to atelectasis.

Group 3. Cases in which extrabronchial pressure, due to neoplasm or aneurysm, enlarged glands or sclerotic tissue, leads to gradual stenosis of the bronchus, the bronchial occlusion being rendered complete either by mucosal turgescence or by bronchial spasm, with retained secretions.

It is recognized that the immediate cause of the atelectasis is bronchial occlusion by retained secretions no matter what the predisposing condition may be.

A number of case histories are given illustrating examples in each of the above groups. The classical symptoms, physical findings and roentgenologic appearance in massive atelectasis are described. The clinical significance of the condition is pointed out, and the necessity of differentiating it from pneumonia, pleurisy with effusion and acute cardiac accident is emphasized. The treatments advocated are the maneuvers suggested by Sante or bronchoscopic aspiration as proposed and practised by Jackson and others.

The great variety and number of conditions which may predispose to passive pulmonary atelectasis are reviewed by the author.—*Karl Kornblum.*

Fishberg, Maurice, and Rubin, E. H. Carcinomatous abscess of the lung. *Am. J. M. Sc.*, July, 1929, *178*, 20–29.

In about one-third of the cases of primary carcinoma of the lung cavitation can be demonstrated either clinically or at the necropsy table. This is in contradistinction to metastatic lesions in which cavitation is rare. Because of this tendency to breakdown with cavity formation, the malignant nature of these lesions is likely to be overlooked. In the differential diagnosis tuberculosis and lung abscess must be considered. This differentiation is quite important. The diagnosis of malignant abscess can be made in the majority of cases.

The diagnosis is based upon the following more or less characteristic features. Carcinomatous abscess of the lung is found in persons of the cancer age, usually after thirty-five. The onset is usually insidious. It is a unilateral condition, accompanied by an abundant and quite fetid sputum in which at times cancer cells can be demonstrated. Severe pain in the chest with radiation to the shoulder of the affected side is common. Hyperesthesia of the chest wall is a characteristic symptom. There is usually high fever and at times chills and profuse sweating. Repeated and sometimes profuse hemorrhages, which may prove fatal, occur. Dyspnea is common and occurs early. Massive pleural effusion is a frequent complication. There is an absence of such etiologic factors as tonsillectomy, extraction of teeth or surgical operations on the jaws so common in lung abscess.

The roentgenologic examination in many cases is not helpful in the differential diagnosis. There is one type, however, in which the roentgenologic appearance is characteristic. This is described as follows: There is a circular shadow which may be several inches in diameter, partly filled with fluid which may be seen to shift under the roentgenoscope when the patient's position is changed. The capsule may be very thin, though at one side it is almost invariably thickened. In some cases the circular shadow may be homogeneous, clearly showing that we are dealing with a new growth or a cyst.

Short case histories of 15 patients are given, this being the number in which cavitation was found in a series of 51 cases of primary cancer of the lung coming to autopsy.—*Karl Kornblum.*

Renaudeaux, and Lejard, Ch. Présentation d'un cliché de cancer miliaire secondaire du poumon. (Presentation of a plate of secondary miliary cancer of the lungs.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1929, *17*, 147–148.

The authors present the roentgenogram of a patient aged sixty-eight years who suffered from metastatic carcinoma to the lungs, and in connection with this they discuss the differential diagnosis from miliary tuberculosis. In many instances, as for example in the case mentioned, a differentiation is very difficult.—*T. Leucutia.*

Laurell, Hugo. Ein Beitrag zur Deutung der sogenannten Ringschatten in den Lungen. (Interpretation of annular shadows in the lungs.) *Acta radiol.*, 1929, *10*, 72–119.

Annular shadows in the lung fields are ordinarily of pleural or pulmonary origin but may be caused by structures in the wall of the thorax. The different forms can easily be differentiated by careful roentgen examination. The author considers only large pleuropulmonary annular shadows more than 1.5 cm. in diameter. The great majority of these are due to a thickened marginal zone, wholly or almost wholly surrounding a round hollow space that contains air. This marginal zone appears as a ring and the inner boundary of the ring from the air cavity is sharp. The author thinks that annular shadows from circumscribed pleurisy are rare, if they occur at all, and show quite different characteristics from the annular shadows from cavities in the lungs or pleura. A distinction must be made between pleuropulmonary annular shadows that change their size and shape slowly and ones that decrease or disappear relatively quickly—in a few weeks or a few months. The more durable ones are ordinarily due to tuberculosis cavities, but they may be due to other things, such for example as spherical bronchiectases. The regular round form of the cavities is due to the elasticity of the lung tissue which tends to enlarge any cavity uniformly in all directions. Temporary annular shadows are probably also due in some cases to tuberculosis cavities. A decided decrease in the size of a cavity within the course of a few weeks can hardly be due to cicatricial contraction; it seems more probable that the decrease in the size of the shadow is due to the bronchus being temporarily occluded in some way and the air being partly absorbed. This presupposes that there is not much purulent secretion from the wall of the cavity. They may also change size more rapidly if there is a valve closure of the bronchus. The sharpness of the shadow may also change under varying pressure conditions. Such shadows may also sometimes be caused by large interstitial (subpleural and interlobular) emphysematous vesicles and perhaps also by bullous emphysematous vesicles under hyperpressure. Typical annular shadows cannot be caused by encapsulated pleurisy but may possibly occasionally, though rarely, be due to an encapsulated pneumothorax.—*A. G. Morgan.*

Chandlee, Gertrude J., and Burvill-Holmes, E. Clinical and roentgen ray findings in the study of the heart and the great vessels. *Am. J. M. Sc.*, September, 1929, *178*, 364–378.

A study of 100 cases in which the clinical findings, including electrocardiographic studies, are correlated with the roentgenologic observations. A short résumé of the previous work done in the study of cardiovasular disease by means of the roentgen ray is given.

The importance of roentgenoscopic observation in the degree, rapidity, and character of pulsation and the presence of pulsation in abnormal cardiac shadows is emphasized. Abnormal hearts are classified as either inspiratory or expiratory in type. The heart in obesity is an example of the expiratory type, and is regarded as abnormal in physiology even if not the seat of pathological changes in structure. Attention is called to the overactive heart of children and young adults as an entity which can be recognized by roentgen-ray and clinical examination.

In hypertension, while there is no characteristic silhouette, the marked pulsation noted by roentgenoscopic examination confirms the clinical observations. Emphasis is laid upon the roentgenological study of the pulmonary area in the differentiation between functional and organic heart disease. Accentuation of the pulmonic curve is particularly marked in patent ductus arteriosus.

In uncomplicated mitral regurgitation hypertrophy of the left ventricle is usually the only roentgenologic finding. This in itself does

not suffice to establish the diagnosis. When associated with mitral stenosis the prominence of the left auricular curve aids in the diagnosis of mitral disease. Mitral stenosis is characterized by the more or less prominence of the auricular curve.

The characteristic findings in pericarditis, both in the chronic adhesive pericarditis and pericarditis with effusion are described. The value of the lateral view in this condition is emphasized.

In certain cases of aortic insufficiency it was possible to diagnose an associated aortitis on the roentgenogram. This was evidenced by a dilatation of the descending aorta which casts a definite shadow to the left of the upper mediastinum below the horizontal arch. This shadow was never found in cases of aortic regurgitation of uncomplicated rheumatic origin but was regarded as evidence of the syphilitic nature of the regurgitation.

In congenital heart disease the authors found no characteristic silhouette for any one type of lesion. A close correlation between the clinical findings and roentgen-ray observations are necessary to establish the diagnosis.

In this series there were 3 cases of aneurysm of the heart and 4 of the aorta. In these the usual roentgenologic characteristics were demonstrated.

In arterial sclerosis attention is called to the upward tilting of the silhouette of the horizontal arch and the detection of atheromatous changes in the vessel walls.

In 74 of the 100 cases studied there was a history of measles, pneumonia, bronchitis or pertussis. The authors believe that the rôle of such respiratory infections in heart disease is the most important clinical contribution derived from their study.

Many illustrations showing the method of measuring the cardiac silhouette, and giving the characteristic appearance of many pathologic conditions and numerous electrocardiographic tracings are included in the article.—*Karl Kornblum.*

MOREAU, LAURENT. A propos des mensurations de la crosse aortique. (On measurements of the aortic arch.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 215–218.

After describing in detail the anatomic relations, the author analyzes the roentgenologic appearance of the aortic arch in the different views. (1) As is known from the classical work of Vaquez and Bordet, the aortic arch in the frontal position measures 5 to 5.5 cm. at the age of forty. The author found that this figure is too high. If, as measured in cadavers, 27 mm. is attributed to the horizontal portion and 18 mm. to the descending portion of the arch, this makes a total of only 4.5 cm. The higher figure of Bordet and Vaquez is due to the fact that the two semidiameters which make the cross section of the roentgenologic aortic arch are measured at the point of greatest bulging. For this reason, and especially on account of the fact that the left semicircle of the arch often varies with the inflection of the aorta, the author is of the opinion that the measurement of the aortic arch in the frontal position does not always give a true picture of the condition present.

(2) In analyzing the appearance of the aortic arch in the right anterior oblique position the author found that an angle of from 30 to 40° permits the clearest definition of the ascending aorta and consequently the best position for its measurement. However, while Vaquez and Bordet found a figure of from 2 to 2.5 cm. for the average cross section of the aorta between the ages of thirty and forty years, the anatomic measurements carried out by the author indicate a value which is slightly higher, the average being 2.7 cm.—*T. Leucutia.*

PALMIERI, G. G. Über meine Methode der plastischen Darstellung des Herzens am Lebende. (Method of plastic representation of the heart in the living subject.) *Acta radiol.*, 1929, *10*, 127–166.

The author describes and explains the theoretical and technical principles of his method of roentgen reconstruction of the heart. This method, which is called radioplasty, has lately been modified by Lysholm and Berg-Schatzki. He also reports the chief results obtained emphasizing the demonstrability of the plastic model, which is particularly suitable for lecture use, and is superior to the orthodiagraph, which only shows two dimensions of the heart which is a three-dimensional body. By comparing the roentgenogram with the plastic model the author brings out the mistakes which are commonly made in interpreting the former,

discusses the position of the apex of the heart in the front view, and demonstrates the unreliability of the profile view; finally, he attempts an interpretation and a detailed analysis of the vessel shadow on the roentgenogram, using the radioplastic method to determine the distance of the various parts from the surface.—*A. G. Morgan.*

Abdomen

Gutmann, R.-A. A propos de la signification radiologique des ulcères duodénaux "de face." (Concerning the roentgenological significance of duodenal ulcers "en face.") *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 171–174.

Three cases of duodenal ulcer localized "en face" are briefly described and their roentgenograms presented.

The following conclusions are drawn in connection with these cases: (1) The normal appearance of the duodenal bulb in one or several films of serial roentgenograms does not eliminate the presence of a duodenal ulcer. (2) It is better to obtain films with the duodenum half empty than with the duodenum filled for a niche often shows to advantage in an empty or half empty duodenum. (3) Films taken with the patient lying down are of greater aid in diagnosing duodenal ulcers than films with the patient standing up. (4) It is a mistake to believe that the diagnosis of duodenal ulcer can be made by roentgenoscopy alone. For the ulcers "en face" the roentgenograms are often of greater help.—*T. Leucutia.*

Öhnell, H., and Lindblom, K. Air filled bile ducts in a case of fistula between the duodenum and the common bile-duct. *Acta radiol.*, 1929, *10*, 121–126.

Fistulae between the bile ducts and the digestive tract are quite uncommon and the authors have not found any cases in the literature in which a description is given of the appearance of the bile ducts filled with air. They describe a case in a woman aged sixty-one with a history of attacks of gallstones. From their examination they made a diagnosis of chronic cholecystitis and perforation of the duodenal cap. Operation showed the small, contracted, hard gall-bladder adherent to the omentum and duodenum. Incision showed a fistula as large as a pencil into the common duct. The common duct, which was as large as a man's finger, was opened. Large amounts of air rushed out under high pressure with a loud hissing noise, together with a frothy sort of bile. Two long smooth stones, one the size of a Spanish nut, were scooped out of the common duct.

The operation was on Dec. 21. On Dec. 10 a roentgen examination had been made without tetragnost to exclude cancer of the stomach and verify the possible presence of gallstones. This examination showed marked deformity of the duodenal cap. Roentgen diagnosis: duodenal ulcer with periduodenal changes. No gallstones could be detected. But on account of clinical signs of biliary disturbance the patient was sent back for cholecystography (tetragnost by mouth). On this examination on Dec. 15, twelve hours after taking the tetragnost, a tree-like system of rarefactions could be seen in the liver shadow with its center at the porta hepatis. At the site of the gall-bladder there was a funnel-shaped rarefaction becoming narrower upward and passing at the top into a narrow, band-shaped rarefaction with jagged outlines. Diagnosis: penetrating ulcer with perforation into the bile ducts.

The authors question whether air-filled bile ducts are really unique or whether they have not been reported before because of lack of attention to them.—*A. G. Morgan.*

Gally, and Bernard. Deux cas de diverticules congénitaux du tube digestif à localisation assez rare. (Two cases of congenital diverticula of the digestive tube, with rather rare location.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1929, *17*, 158–159.

The first case is that of a diverticulum of the greater curvature of the stomach in a woman sixty-one years of age, suffering from gastric carcinoma, while in the second case the diverticulum involved the ileum near the ileocecal valve.

The cases are presented because of the rather unusual location of the diverticula.—*T. Leucutia.*

Baumel. Les périviscérites digestives. (Digestive perivisceritis.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 205–206.

Twelve cases of digestive perivisceritis verified at operation are briefly presented.

The condition was either localized or generalized. Of the localized forms in some instances the lesion was confined to the right (stomach, gall-bladder, appendix) and in others (syphilitic sigmoiditis, vesico-intestinal fistula) to the left side. The generalized types developed as a result of surgical interventions and they were either progressive, all forms of treatment remaining without avail, or regressive when the medical or surgical treatment led to excellent results.

Every case of perivisceritis should be considered tuberculous until proved otherwise.—*T. Leucutia.*

DARBOIS, and SOBEL. Au sujet d'un cas de dextro-position du grêle et de sinistro-position colique. (A case of dextro position of the small and sinistro position of the large intestine.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1929, *17*, 145–146.

A case of a dextro position of the small and sinistro position of the large intestine was observed in a young man with indefinite clinical symptomatology (spells of intermittent pain in the left upper quadrant, attacks of diarrhea and constipation, general debility, etc.). It must be mentioned that the patient suffered at the same time from pulmonary tuberculosis and it may be that all his symptoms were due to that condition.

The intestinal anomaly is no doubt congenital and is similar to that described by Dillenseger.—*T. Leucutia.*

BALLI, R. The sphincters of the colon. *Radiology*, June, 1929, *12*, 484–495.

The author presents the roentgenology, surgical aspect and histology of the sphincters of the colon. Roentgenoscopically, cylindrical fragments are passed from the ileum into the large intestine, through peristaltic action of the terminal end of the ileum. The entry into the cecum may, however, cease entirely, even if the terminal ileum be full and in active peristalsis. All this corroborates the presence of an ileocolic sphincter of Varolius exercising active control. The sphincter of Busi, or colicocecal sphincter, is described, from the roentgenologic point of view, as a sphincter between the cecum and the ascending colon below the ileocecal orifice. It is not uncommon to find in the cecum contemporaneously with the sphincter of Busi, and in relation to its lower border, an incisura which represents the contraction of a tenia (the anterior). The author believes that the action of the sphincter of Busi and of this small band are important in the progress of contents passing from the cecum to the colon. The sphincter of Hirsch may sometimes be found near the hepatic flexure, and it may assume the shape of a sphincteric tract. The cecocolic segment shows an active retention of the intestinal contents until the cecal digestion and reabsorption are complete. Spasm of the sphincter of Hirsch has been noted in various diseases of the colon. The sphincter of Cannon is found in the transverse colon about the junction of the first and third portions. In the normal state of tonic contraction it becomes visible as a sudden narrowing of the haustral formations. Spasm of the sphincter has been seen in some cases of cholecystitis, in functional stenosis of the third portion of the duodenum, constipation, appendicitis with adnexal adhesions, and in digestive vagotonia. The sphincter of Payr and Strauss is situated at the left flexure of the colon. The colosigmoidal sphincter is produced by a tonic or spastic contraction of the colon at its junction with the sigmoid. The sphincter of Moutier is situated in the terminal colon between the sigmoid and the rectum. The roentgen examination discloses the modifications in peristalsis and tone and the discoordinated action of the sphincters which modify and alter the normal action of the colon. In dealing with the surgical aspect, the author states that the antiperistaltic reflex following ileosigmoidostomy is associated with the existence and function of the sigmorectal sphincters below the anastomotic mouth, and with the presence above of an empty colon deprived of normal activity for want of physiologic stimulus. His studies tend to confirm the common processes of adaptation to the profound modifications produced by surgery in various parts of the gastrointestinal tract, by which a compensatory system is established so as to permit the reassumption of function, not identical, but at least approximating the normal physiological regime. In the light of anatomic studies, only four of these sphincters, the sphincter of Varolius, Busi, Hirsch and Moutier, present definite muscular markings which justify the term "sphincters" in the true sense of the word. The others are func-

tional sphincters, without anatomic substrata. The anatomic arrangement, wich indicates the presence of other non-autonomous fibers from other parts, seems to him to explain the normal or pathologic correlation between the action of the cecum and colon, and between the ileum and the cecum, giving this region importance anatomically, physiologically and clinically.—*J. D. Camp.*

GENITOURINARY SYSTEM

Judd, E. Starr, and Hand, John R. Carcinoma of the renal cortex with factors bearing on prognosis. *Arch. Int. Med.*, Nov., 1929, *44*, 746–771.

Grawitz gave the first description and showed the relation to the suprarenal gland. Birch-Hirschfield termed the tumor hypernephroma. Adami suggested "mesothelioma." Sudick favored renal adenoma. Stoerk believed tumors arose from secreting epithelium of convoluted tubules. Wilson and Willis thought tumors arose from islands of nephrogenic tissue as against the theory of Grawitz that they came from suprarenal rests. The present view is that all epithelial tumors of the cortex are carcinoma. Foulds and Braasch have pointed out two groups of cortical tumors, adenocarcinoma and alveolar carcinoma.

The material studied was 367 cases of carcinoma of the kidney seen at Mayo Clinic from Jan. 1, 1901, to Jan,. 1, 1928. Of 312 patients who had nephrectomy 283 have been traced. Of 55 explored 47 have been traced. Adenocarcinoma is considered the same as hypernephroma and the more malignant group as alveolar carcinoma.

Pathology. Adenocarcinomas are associated with tortuous superficial dilated veins. In 52 patients these lesions were limited to the upper pole, in 60 to the lower pole and in 39 in the mid-renal region. In 10 the entire kidney was involved, and in 123 the involvement was in continuation of the above mentioned. In 104 the capsule was broken and the perirenal tissues involved. There was extension into renal veins in 51 cases and metastasis in 98 instances.

In advanced cases extension was by continuity; the renal pelvis often obstructed with hydronephrosis.

From the histological picture it is possible that a few alveolar carcinomas may arise from suprarenal rests. The proportion of alveolar carcinoma to adenocarcinoma was 43:287.

The lesion involved the right kidney in 169 cases and left in 196 cases, in 2 the side was not described. Of 26 out of 283 cases who survived operation ten years, 15 had the lesion on right side and 11 had the lesion on left.

Relation of age to onset of symptoms and postoperative length of life in renal carcinoma:

In the entire series the average age of onset was 51.76 years. In 63 per cent the first symptom occurred between the ages of forty and sixty and in 37 per cent between fifty and sixty years. In 192 patients who had nephrectomy and are dead the average age at operation was 52½ years, and duration of postoperative life was twenty-eight months. In 91 cases who had nephrectomy and are still living the average age is 47.01 and average age of operative life so far is eighty months. Of 47 explored 45 are dead. In these cases the average onset was 50.84 years and average age at operation 53.11 years with an average postoperative life of 1.72 years. In 2 of the latter series living the onset was at thirty-five years and operation at forty-one years, with present postoperative life of 29.5 months.

Of the 367 patients 116 were women and 251 were men. The average duration of symptoms before nephrectomy in 191 men was 28.14 months and in 92 women 26.64 months. The average duration of symptoms and postoperative duration of life both of patients living and those dead are less for women than for men, which suggests that possibly renal carcinoma runs a more rapid course in women. It was noted that the average duration of symptoms in women is less because they sought medical attention earlier, but in spite of this they had a shorter postoperative life. The proportion of inoperable cases is less in women, for this above-mentioned reason, no doubt.

The average length of symptoms was longer before operation in the cases of adenocarcinoma than in those of alveolar carcinoma. Early surgery is necessary for the best postoperative results. In the cases of exploration the average postoperative life was 5.87 months less in alveolar carcinoma. Only 2 of the exploratory cases are living and both are adenocarcinoma.

Pain as a symptom was present in 307 of the

367 cases. Hematuria was present in 254 cases, a tumor was noted in 291 cases, weakness in 29, absence of urinary disorder in 8 and absence of illness in 2. The mortality is increased as the tumor becomes palpable. Tumors of the lower pole of the kidney have a slightly less postoperative life; one reason may be that they may interfere with renal drainage. The larger the tumor, the shorter the postoperative life. It was noted that the mortality rate was less in cases with the higher hemoglobin. Involvement of the renal veins increased the mortality rate, metastasis and subsequent pyelophlebitis playing a part as the contributory cause. This condition also hampers good hemostasis in the operative field. There is a much lower mortality rate in cases without perirenal involvement. In cases of perirenal involvement metastasis and recurrence play major parts as factors in the mortality. There was a higher percentage of recurrence and metastasis in cases without perirenal involvement and this would seem to indicate that the gross pathologic condition is not an exact criterion as to whether or not extension has occurred.

In the last few years the posterior surgical incision has been used in nearly all cases. From the authors' statistics it is shown thus that the post-operative life was shorter in cases in which it was necessary to change the pedicle at operation rather than ligate it. From the authors' experience removal of the upper part of the ureter is indicated and is sufficient in practically all cases of renal carcinoma.

Recurrences were noted in 51 cases in which nephrectomy was performed. Local recurrences were noted in 31 cases or 26.65 per cent of the cases with perirenal involvement.

Definite evidence of metastasis was found at necropsy in 31 cases, in 13 at operation, in 23 at subsequent operation and 31 from attending physicians and relatives. Visceral metastasis occurred in 56 per cent. Bony metastasis was found in 11 cases. In 17 cases the lymphatics were involved and in 14 cases the surrounding structures were involved by direct extension. Distant metastases were found in 13 cases. Pulmonary metastasis occurred in 24 of 30 cases. In 5 cases metastasis to the brain was noted.

The average postoperative life of patients with postoperative roentgen and radium treatment was less than in cases which were not so treated, but the author states that the cases with the poorer prognoses were the only ones irradiated. In the series, cases of bilateral hypernephroma, hypernephroma with polycystic disease and a hypernephroma in an ectopic kidney are described. In 10 cases renal lithiasis was found associated with renal carcinoma.

An analysis of data from patients living ten years or more after operation showed all the cases to be adenocarcinoma, the average age of this group was two years less than that of the entire series that underwent nephrectomy, the right side was the most frequent site of involvement, and only 42 per cent had palpable tumors. In adition, the tumors removed in this group are classified as generally smaller than those in the group at large.

The prognosis is dependent on several factors: (1) the degree of cellular differentiation of the carcinoma, or whether the case is one of adenocarcinoma or alveolar carcinoma; (2) the duration of symptoms before operation; (3) movability of tumor; (4) the hemoglobin at the time of operation; (5) presence or absence of metastasis, and (6) presence of infection.

In conclusion, the authors state that carcinomas of the renal cortex are extremely malignant and are often well advanced before onset of symptoms. The end-results of nephrectomy in their 106 cases in which the patient lives from 3 to 22.5 years make them believe that nephrectomy is justified in these cases.

The article contains several illustrations and tables.—*E. P. Pendergrass.*

NERVOUS SYSTEM

Zimmern, A., Chavany, F.-A., and David, M. A propos d'une fausse sciatique (tumeur intra-médullaire). (Concerning a pseudo-sciatica (intramedullary tumor).) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1929, *17*, 105–106.

A woman twenty-seven years of age was first observed by the authors in June, 1926, complaining of very intensive pain along the right sciatic nerve. A diagnosis of true sciatica was made and the patient treated by physiotherapy (roentgen therapy, galvanic electrization, diathermy, etc.). Since there was no improvement myelography was performed

several times but the examination always remained negative for evidence of an organic lesion.

Eighteen months later the patient was submitted to an exploratory laminectomy (from the sixth cervical to the third dorsal) and an intramedullary spinal cord tumor was found which on microscopic examination proved to be a spongioblastic neuroepithelioma. The patient died following the intervention.

The case is decribed on account of the fact that there was a symptomatology which is typical for sciatica and repeated myelographic examinations failed to reveal the true nature of the lesion.—*T. Leucutia.*

Skeletal System

Goodwin, William H. Tumors of the bone. *Arch. Surg.*, June, 1929, *18*, 2353–2385.

This is a report of 10 cases of bone tumors, including case histories, photographs of the patients, roentgenograms of the tumors and metastastic lung lesions, photographs of the gross specimens and a number of photomicrographs. Six of the tumors were typical osteogenic sarcomas, two were typical giant cell tumors and the others, borderline varieties of these. In both the osteogenic sarcomas and giant cell tumors the clinical and roentgenological manifestations were more or less characteristic. In the two borderline cases in which the clinical and roentgen-ray findings were not sufficient to establish the true nature of the tumor, microscopical studies of the neoplastic tissue were also confusing.

Coley is credited with the assertion that 50 per cent of cases of osteogenic sarcoma present a history of trauma definitely related to the onset of the tumor. The history of trauma, however, is not always reliable. Osteogenic sarcoma is most common between the ages of ten and twenty when injuries are frequent, yet the incidence of these tumors is quite low. There is recognized a similarity in the reparative process of growing bone and osteogenic sarcoma.

These tumors show variations in the amount of bone production. As a rule the more bone present, the less malignant is the tumor. The characteristic perpendicular, fan-like rays seen on the roentgenogram and described by Eising have been shown by Coley to occur in only 18 per cent of cases. Kolodny from a study of the material of the Registry of Bone Sarcoma concluded that it is often impossible to determine from the roentgenogram or the gross specimen whether or not the tumor originated from the periosteum, cortex, or had a central origin.

Attention is called to the fact that in certain bone tumors all methods of diagnosis may fail to reveal the nature of the growth. Cooperation with the Registry and study of the material being accumulated would aid in establishing greater accuracy in diagnosis.

The clinical and roentgenological characteristics of the typical osteogenic sarcoma are given. The tumor occurs in a young individual, pain being the first symptom. This usually follows an injury, often trivial. Later there is tumor formation, most frequent in the lower end of the femur or upper end of tibia. Clinically the tumor is fusiform, hard and fixed. The skin is smooth and glazed, superficial veins are prominent and the surface temperature is elevated. The neighboring joint is not directly involved. On the roentgenogram will be seen a tumor completely surrounding the shaft of the bone, the periosteum raised or broken through. Perpendicular striae may be present but often the new bone is laid down parallel with the shaft. In very large tumors, there may be a diffuse, irregular and spotted appearance of calcification. With the central and subperiosteal sarcomas pathologic fractures are common. With this occurrence there is rapid invasion of the soft parts and early metastases to the lungs.

The treatment of osteogenic sarcoma consists of amputation, radiotherapy and the use of the mixed toxins of Coley but in this regard the author states, "The number of five year cures reported in the literature is too small to create much enthusiasm over any method of treatment."

The characteristics of the giant cell tumor are contrasted with those of the osteogenic sarcoma. Here a history of trauma is also frequent. It is most common in the third decade; its incidence is one-third that of the osteogenic sarcoma. It occurs most commonly in the ends of the long bones and does not involve the joint. The cortex is expanded and the periosteum intact. When the periosteum is ruptured by fracture or biopsy the tumor does not tend to infiltrate the soft tissues but grows in the planes of least resistance. Likewise it does not invade the marrow cavity. On

the roentgenogram the tumor is spherical, trabeculated and multicystic. The shaft of the bone is not present. Although the clinical and roentgenologic manifestations of giant cell tumor are fairly typical, Coley, nevertheless, found a 20 per cent error in diagnosis when based on these two methods of examination alone.

In the treatment of giant cell tumor many surgeons prefer curettage and swabbing the the cavity with an escharotic. This may be followed by irradiation and toxins. Irradiation will prevent recurrence but may do serious damage to the growth of the bone. As regards primary radiotherapy in giant cell tumor, the author gives the following opinion: "A disadvantage of primary radiotherapy in these tumors is that in case of an error in diagnosis valuable time will be lost in instituting radical treatment. Furthermore, radiotherapy should be directed by an experienced, well equipped radiologist since under treatment has a stimulating effect on neoplastic growth and overtreatment may cause the tissue to break down, or may produce such brittleness that fractures occur easily, or set up an endarteritis, accompanied by such pain that amputation will have to be done."

Between the osteogenic sarcoma and giant cell tumor variants occur that offer much difficulty in diagnosis. In such cases a biopsy should be done with the provision that radical operation be immediately performed in case the tumor is found malignant.—*Karl Kornblum.*

DIDIÉE, J. Un cas d'arthropathies multiples chez un hémophile. (A case of multiple arthropathy in a hemophiliac.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1929, *17*, 154–157.

Arthropathies form an important part of the clinical picture of hemophiliacs. They are encountered in the earliest stages of the disease and occur especially in the large joints. According to the stage of development they may be divided into three groups: (*a*) hemarthrosis; (*b*) chronic arthritis (panarthritis of König), and (*c*) articular deformations.

Hemarthrosis is characterized roentgenologically by thickness of the joint capsule, effusion of the blood with or without calcification and occasionally lipping.

The advanced stages appear on the roentgenograms as destructive processes. Thus according to Doub there is either localized destruction of the articular cartilage with thickening of the capsule or more generalized destruction of the articular cartilage with punched out areas in the epiphysis, or finally there is marked calcification of the organized blood clot with rounded areas of destruction extending into the epiphysis.

The roentgen appearance of the arthropathies occurring in a patient thirty-seven years of age is described in lengthy detail. On the basis of the observations made the evolution of the disease is characterized as follows: (1) general, rather homogeneous decalcification of the bones with zones of punched out areas near the epiphysis, and a linear densification of the bone shell itself; (2) more or less uniform destruction of the articular cartilage, however without complete disappearance of the joint space; (3) periarticular osteophytic formations with occasional intra-articular extension, and finally (4) modification of the articular segments, permitting a molding of the epiphyseal endings as in osteomalacia.

Differential diagnosis includes tuberculous arthritis, tabetic arthropathies and syringomyelia.—*T. Leucutia.*

TAFT, ROBERT B. Osgood-Schlatter's disease. *Radiology*, May, 1929, *12*, 414–418.

The author reports 9 cases. It is his belief that the disease is not so rare as is generally supposed, but often escapes notice. He states that Osgood-Schlatter's disease is an epiphysitis of the tibial tuberosity, pre-existing, but accentuated by a moderate injury. It is not associated with any other disease. Splinting is the only treatment needed in most cases.—*J. D. Camp.*

SCHOR, M. I., and GOLDSTEIN, L. M. Weichteilveränderungen als Quelle diagnostischer Fehler bei der röntgenographischen Untersuchung des Knochensystems. (Soft tissue changes as a source of diagnostic errors in roentgenographic examination of the bony system.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, September, 1929, *40*, 486–491.

The authors investigated on cadavers the influence of soft tissue defects of different sizes and depths on the roentgenographic appearance

of the bony system. They found that if such defects project over the normal shadow of the bone they lead to areas of increased translucency which may be erroneously interpreted as pathological areas of bone rarefaction.

The opinion is expressed that the influence of soft tissue shadows on the roentgenologic appearance of the bony skeleton is much greater than hitherto supposed.—*T. Leucutia.*

Hultén, O., and Lovén, K. A. Ein Fall von multiplen Hämangiom-Chondromen in Skelett und Weichteilen. (A case of multiple hemangioma-chondromas in the skeleton and soft parts.) *Acta radiol.*, 1929, *10*, 173–181.

A case of multiple angiomata and chondromata is described in a patient, aged twenty-seven, who had been well most of his life. About ten years ago he noticed a number of nodules on his right hand and right foot but they were never painful or sensitive to pressure. They increased in size and number; they never interfered with his work but he finally came for examination because he feared they might become dangerous. Examination showed multiple angiomata and chondromata which in some places were entirely independent of each other and in others intimately connected. They were chiefly on the right hand and foot and in the right iliac bone. The angiomata appeared on the roentgenogram as calcified phleboliths, while the chondromata were shown by lacunar swelling of the affected bones. Such combined tumors are rare but a few cases have been published, two of them with roentgenograms.—*A. G. Morgan.*

Loewenberg, Richard Detlev, and Wehmer, Max. Über Wirbelarthropathie und Amyotrophie bei Tabes dorsalis. (On spinal arthropathy and amyotrophy in tabes dorsalis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, September, 1929, *40*, 492–496.

Two cases of arthropathy of the lumbar spine (occurring in tabes dorsalis) are described, the first with illustration by roentgenograms and the second with a presentation of a cross section of the specimen.

In the first case the lesion was confined to the second and in the second case to the first lumbar vertebra, an entire destruction of the vertebral bodies having been produced. In one case there was also evidence of amyotrophy of the small muscles of both hands.—*T. Leucutia.*

Didiée. Une position nouvelle pour la radiographie de la tête humérale: son intérêt dans l'étude de la luxation récidivante de l'épaule. (A new position for the roentgenography of the head of the humerus; its significance in the study of recurrent luxation of the shoulder.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1929, *17*, 150–154.

In order to better visualize the contour of the head of the humerus and its relation to the glenoid cavity, the author recommends the following technique: The patient is placed in ventral decubitus with the head turned on the side and the hands placed on the hips so that the humerus is in maximum internal rotation. The elbow is slightly elevated by an object 6 by 8 cm. The tube is placed above the elbow and inclined 45° to the horizontal plane and centered over the head of the humerus.

The position is of value especially in recurrent subluxation of the shoulder since it permits the detection of changes which are not visible in other positions. Thus the contour of the head of the humerus is often modified and there is evidence of a depression or notch near the epiphyseal line associated with a zone of decreased density below the epiphysis. These changes are no doubt the result of a chronic mechanical irritation.—*T. Leucutia.*

Breitländer, Kurt. Knieatrophie im Röntgenbilde. Trauma oder Tuberkulose? (Atrophy of the knee in the roentgenogram. Trauma or tuberculosis?) *Acta radiol.*, 1929, *10*, 182–185.

The patient was a young man of nineteen, who came to the surgical clinic because he had had painful swelling of the right knee for seven weeks following a fall. His physician had punctured twice and obtained a turbid serous fluid. He had been able to walk and had not had fever. The first roentgen examination showed extensive atrophy of the subchondral bone and epiphyseal lines of the femur and tibia, together with a curious peripheral atrophy of the patella. From the roentgen appearance and the slow course following a slight trauma a diagnosis of serofungous tuberculosis was made and the joint treated by extension for a little while followed by a plaster

cast and roentgen irradiation. The knee continued swollen and painful and the patient had subfebrile temperatures. Four weeks later he came to the clinic and said that a piece of wood had been discharged from a fistula. The diagnosis of tuberculosis was given up and he was given diathermy and medico-mechanical treatment. In eight weeks the joint movements were normal and the roentgenogram showed normal structure of the bone. The skin scar had not been noticed on examination and the patient himself did not know there had been any injury of the skin at the time of his fall.

This case shows the danger of making a diagnosis of synovial tuberculosis from the roentgen picture alone and the necessity for caution in the interpretation of all doubtful cases of joint tuberculosis.—*A. G. Morgan.*

Belot, and Buhler. Os surnuméraire du carpe et traumatisme. (Supernumerary bone of the carpus and traumatism.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1929, *17*, 114–115.

A peculiar accident was observed in a woman forty years of age who while taking care of a child nine months old was kicked in the region of the left wrist. Since this apparently light trauma was followed by intensive pain, later roentgenograms of the wrist were taken and a supernumerary carpal bone (os ulnare exterunm) was detected.

The pain continued for a period of several weeks indicating that even light traumas may produce rather severe symptoms in case of supernumerary bones.—*T. Leucutia.*

Doub, H. P. Intrapelvic protrusion of the acetabulum. *Radiology*, May, 1929, *12*, 369–376.

Eight cases of inward protrusion of the acetabulum are reviewed. The condition is rare, though first described more than a hundred years ago. Its cause has not been ascertained, and several factors are probably concerned. Osteoarthritis is a common accompaniment, and this may be a late stage of some general disease in early life causing softening of the bones with the resultant deformity. Clinical findings refer mostly to pain and restriction of normal motion of the hip. The roentgen picture discloses a deepening of the acetabulum with thinning of the mesial and inferior wall and bulging of the acetabulum into the pelvis. The head of the femur is therefore more deeply buried and the greater trochanter is somewhat higher and closer to the acetabulum.— *J. D. Camp.*

Johnson, H. F. Unusual bony injuries about the hip joint. *Surg., Gynec. & Obst.*, November, 1929, *49*, 630–637.

Fracture of the neck is the most frequent fracture of the femur.

Whitman's abduction position is used in treatment of this fracture.

In children epiphyseal separation occurs of the head of the bone. Traumatic dislocations of hip are rare in children. In 1842 dislocations, only 3 were in young individuals. Dislocations of the head may carry the entire rim of the acetabulum with them and require open operation for reduction.

Central fracture of the acetabulum with or without central dislocation of the head of the bone is a difficult fracture problem. Very rarely in young individuals there may be a separation of the epiphyses of the acetabulum. A case is noted where there was 3/16 of an inch separation of the acetabulum epiphyses.

Fractures of the head of the femur are very rare. Christopher was able to collect only 9 proved cases.

Traction fracture of the lesser trochanter occurs most frequently as epiphyseal separation between the ages of twelve and eighteen years.

Fracture confined to the greater trochanter is rare. The author reports one case.—*L. R. Sante.*

Rechtman, A. M. Pneumarthrosis of the knee. *Surg., Gynec. & Obst.*, November, 1929, *49*, 683–687.

The injection of oxygen into joints as an additional aid to diagnosis is worthy of wider use than it now is given. It is preferable to replace the generic diagnosis of an internal derangement of the knee joint with a specific diagnosis as: loose internal or external semilunar cartilage; rupture of the crucial ligaments, loose body in the knee joint, etc. The use of pneumarthrosis will give more accurate preoperative diagnoses, and make operative procedures definite rather than exploratory and

the less the tissues of a joint are handled and manipulated, the more rapid will the postoperative recovery be, while postoperative pain, discomfort, and the possibility of infection are reduced to a minimum.

Fracture or dislocation of the interarticular cartilages of the knee may go unrecognized in the ordinary roentgenogram. Injection of oxygen or other gas nto the joint frequently will disclose an injured or displaced semilunar cartilage which cannot be disclosed in any other manner. A case of fracture of the outer semilunar cartilage is illustrated.

The technique of performing pneumarthrosis is simple. Injection is made under aseptic conditions. A 2 per cent solution of novocain is injected below the patella and to the outer side of the patellar tendon. The patella is lifted and the needle is introduced into the joint so that the tip is beneath the center of the knee cap. If an external cartilage injury is suspected, it is better to introduce the needle from the inner side so as not to obscure the cartilage. The oxygen is allowed to flow into the joint until it is moderately distended. A hemostat is then placed on the tube, the flow of gas stopped, the tube disconnected from the tank, and the anteroposterior view taken. The patient turns on his side and lateral views are made. The hemostat is then removed and the knee deflated. The needle is removed and a collodion dressing applied. A circular sheet wadding and flannel bandages are applied for compression and worn for three or four days when the remaining gas is entirely absorbed.— *L. R. Sante.*

Darbois, and Sobel. Note sur les fractures multiples des apophyses transverses des vertèbres lombaires. (Multiple fractures of the transverse processes of the lumbar vertebrae.) *Bull. et mém. Soc. de radiol. méd. de France*, April, 1929, *17*, 126–128.

A fracture of the transverse processes of the first to fourth lumbar vertebrae with oblique fracture of the body of the fifth lumbar vertebra was observed in a man twenty-seven years of age.

In connection with this a survey of the entire literature as to the existence of fractures of the transverse processes of the lumbar vertebrae was made and 200 cases were collected. In all instances, with the exception of one, the fractures occurred in men.

It is interesting that all fractures of the two lower lumbar vertebrae led to late lesions of the nerves. For this reason it is advocated that an absolute rest of at least six months be prescribed in all such cases.

Differential diagnosis includes ureteral calculi, calcified glands, congenital anomalies of the transverse processes (lumbar ribs, aberrant ossification nuclei), and in individuals after twenty-five years, normal ossification of the transverse processes.— *T. Leucutia.*

Kingreen, Otto. Die Röntgenuntersuchung isolierter Wirbelkörperfrakturen. (Roentgen examination of isolated fractures of the vertebrae.) *Deutsche med. Wchnschr.*, Aug. 2, 1929, *55*, 1302–1304.

A roentgenogram should be taken at once in any injury of the back in which there is the slightest suspicion of injury of the vertebrae, or even perhaps as a routine procedure in injury of the back, for often injury of the vertebral column is not suspected at all. In the last two years 11 patients have been sent to the surgical clinic of Greifswald with a diagnosis of contusion or ruptured muscles of the back or traumatic lumbago a year to a year and a half after injury. In all these cases careful roentgen examination showed fracture of a vertebra. No roentgen examination had been made in 6 of these cases though they had quite serious symptoms and in the other 5 the examinations had been reported negative. There was gibbus in only 3 of the cases but in all of them there was rigidity of the spinal column and weakness of the long extensors of the back. Pictures taken in the ventrodorsal direction with a Potter-Bucky diaphragm in 8 cases showed the body of the affected vertebra broader than normal. The intervertebral space above it was narrower than the others. In 3 cases no pathological change could be seen in the sagittal pictures. But in all the cases the lateral pictures showed compression of the body of the vertebra with a piece broken off at the upper or lower corner. There was also decreased calcium content of the vertebrae above and below the injury. The injured vertebra itself at first seemed richer in calcium than the ones above and below it because of the compression and condensation. But in a year or a year and a half it also shows atrophy. These roentgenograms must be taken with care for an underexposed picture on which the spinal

column is barely visible may simulate atrophy. Pictures should be taken not only in the anteroposterior direction but also in the lateral and possibly in the oblique position. A Potter-Bucky diaphragm should be used. Further details of taking the pictures are discussed.

The cases should also be followed up with roentgenograms to see the results of treatment and to determine the time when the patient is able to go back to work.—*A. G. Morgan.*

Simon, Herbert. Zur Frage der unspezifischen Knochenherdbildung nach Infektionskrankheiten. (Nonspecific foci in bone after infectious diseases.) *Deutsche med. Wchnschr.*, Oct. 11, 1929, *55*, 1714–1716.

Two cases are described, one in a boy of eleven and one in a girl of seven. In both cases after an attack of grip a focus of inflammation developed in the bones; in the first case near the knee-joint and in the second at the hip-joint. The cases show that if joint symptoms develop after an acute febrile disease the possibility of a joint metastasis should be considered and a roentgen picture made at once. Frequently these foci develop during the febrile primary disease, but often not until some time after it, when the temperature rises again. These foci can be differentiated from tuberculosis by generally beginning acutely with fever and pain and the roentgen picture does not show the atrophy around the focus that is characteristic of tuberculosis. The two cases described recovered completely under conservative treatment. It is important to know this particularly when, as in these cases, the focus lies near the epiphyseal line. Of course the cases must be followed up by repeated roentgen examination so that if there is any further extension of the focus, particularly irruption into the joint, surgical operation may be performed.—*A. G. Morgan.*

Moore, Sherwood. The radiological aspects of arthritis. *J. Missouri M. Ass.*, Jan., 1929, *26*, 4–7.

Moore discusses the classification of the arthritides and reviews the literature. The classification he uses embraces the infectious, the atrophic and the hypertrophic types.

In infectious arthritis the roentgen findings are more uncertain than in the other two classes. Thickening of the soft part tissues, increase in size of the interarticular spaces and generalized haziness of all joint structures, preservation of the plate of cortical bone covering the articular aspect of the bone, and a certain amount of atrophy are usually found. The latter is commensurate with the duration and the severity of the disability.

In atrophic arthritis the most striking thing observed is the rarefaction of bone. It seems to be a true halisteresis and far exceeds bone atrophy attributed to disuse. There is no proliferative change. There is some soft part swelling but it is not so pronounced as that observed in infectious arthritis. There is likely to be some degree of luxation which is in the direction of greatest force applied on the bones entering into the affected joint.

The hypertrophic form is characterized by overgrowth of bone along the articular margins. There is relatively no bone atrophy, but there is often an increased bone density in the parts nearest the joint.

Moore feels there is a great need for further roentgenological study of arthritis in its earlier phases. In the early case the roentgen-ray findings are few. The great field of usefulness for the roentgen-ray in arthritic conditions is to eliminate other diseases or conditions which may confuse the picture.—*R. S. Bromer.*

Bunne, Franz. Zur Kenntnis der synovialen Osteochondromatose. (Synovial osteochondromatosis.) *Deutsche med. Wchnschr.*, July 5, 1929, *55*, 1130–1131.

Müller first described this disease and since then about 80 cases have been published. The characteristic feature of it is that from one to several cartilage bodies develop in the joint. They do not originate from the cartilage surface of the joint ends but from the synovial membrane, from any part of which they may develop. The pockets and folds of the synovial membrane and the points of union of the joint capsule with the periosteum are particularly predisposed to cartilage formation. Lexer thinks that trauma is not an etiological factor in the disease. When clinical symptoms begin the joint cavity is often completely or almost completely filled with tumor masses. The capsule is stretched and the tumors may grow through the ligaments but there is no infiltrating malignant growth. Microscopically the tumors are chondromas with areas of calcifica-

tion and ossification. The first symptoms are pain, swelling and impairment of the movement of the affected joint. Generally only one joint is involved. The patients have usually had the disease ten years or more when they come for treatment. If the hip-joint is affected the patient has sciatic pain. Objectively the joint is enlarged, its outlines are obliterated and there are irregular protrusions.

The roentgen picture is very characteristic. There are shadows in the region of the joint which give it a cloudy, spotted appearance. Stereoscopic pictures show that the bone structure of the joint is normal but the whole joint cavity is filled with nodular masses. Sometimes in advanced cases there may be superficial bone defects as a result of abnormal pressure in the joint cavity. Almost always there is more or less atrophy of the bone. There are a number of diseases from which differential diagnosis is difficult, including arthritis deformans, cartilaginous exostoses, old fracture with exuberant callus, myositis ossificans, tabetic arthropathy, old calcified tuberculosis and sarcoma.

Among the 80 cases published there have been only 4 in the hip-joint. The author describes 2 cases he had recently seen in the hip-joint. The first patient was a man aged sixty-four who had never been seriously ill and never had any trauma. His illness began ten years ago with stabbing pain in the left hip-joint and for the past five years had been growing worse. He had been treated for years for rheumatism and sciatica.

The second patient was a man of sixty-five who at the age of sixteen began to have pain in the left hip-joint and limping, no history of trauma; he said that a dislocation of the hip was corrected in a hospital. For a number of years he was well but in 1902 the same symptoms recurred and he wore an apparatus with which he could walk. For the past fifteen years he had worn no splint but the leg had gradually atrophied and the hip become fixed in flexion. He was sent to the author with a diagnosis of old tuberculosis of the hip.

The diagnosis of the condition could not have been made in either of these cases from the clinical picture alone but it was shown definitely by stereoscopic roentgen pictures and the author advises taking such pictures in all cases in which there is any suspision of synovial osteochondromatosis.—*A. G. Morgan.*

GENERAL

Cummins, W. T., Smith, J. K., and Halliday, C. H. Coccidioidal granuloma. *J. Am. M. Ass.*, Oct. 5, 1929, *93*, 1046–1049.

A statistical study of 122 cases of the disease collected from the literature is presented by the authors, 2 of whi.h have not yet been reported. Age, sex, nationality, duration and termination is noted in each instance. It is noteworthy that in a little more than 80 per cent of all cases infection was acquired in California. The disease is caused by a fungus growth and gives a very similar symptomotology to blastomycosis and tuberculosis with which it is usually confused. Pulmonary infection produces lesions similar to pulmonary tuberculosis. Diagnosis is made by finding the organism in fresh pus or in tissue. Numerous examinations of soil have been carried out by the authors in an effort to locate the source of the infection.—*L. R. Sante.*

Pulford, D. S., and Larson, E. E. Coccidioidal granuloma. *J. Am. M. Ass.*, Oct. 5, 1929, *93*, 1049–1056.

Coccidioidal granuloma is a disease of both animals and man, resembling tuberculosis but caused by its own specific fungus, *Oidium coccidioides*. In the last few years it has been shown to be more common than was formerly supposed. Though only approximately 95 cases have been reported in the medical literature, the California State Public Health Service knows of about 175 proved cases. Because the main focus of the disease appears to be in the San Joaquin Valley, California, most physicians living elsewhere think it a rarity. Almost certainly, many people die of this disease erroneously diagnosed as tuberculosis. There is no direct evidence of contagion, the two known portals of entry being the skin and the lungs. The majority of cases have been in adult males of the laboring class. The predominant lesions are in the skin, lungs and bones, and consist of granulomas and cold abscesses. The skin lesions resemble those of tuberculosis, syphilis or blastomycosis. If the initial lesion is in the skin or joint of any extremity, amputation may effect a cure, whereas, after general dissemination, death nearly always results.

An additional case is reported by the authors. The patient, although infected by a virulent

organism, lived one year and four months. During this time, among other measures, colloidal lead, as used for cancer, colloidal copper, as recommended by Jacobson, and intravenous injections of gentian violet were used in the treatment without avail. However, gentian violet did seem to retard the progress of the disease when used in conjunction with roentgen rays. In this case high voltage roentgen therapy was used, but no details of technique are mentioned.—*L. R. Sante.*

Carty, John R. A source of danger in the use of vertical roentgenoscopes and tube stands. *Radiology*, June, 1929, *12*, 496–498.

A definite hazard incidental to the use of heavy weights on roentgen apparatus is shown to exist. The author feels that more attention should be paid by the manufacturers of roentgen apparatus to means of obviating such dangers. Regular visual inspection can be relied upon to detect failure due to wear, but not to defective material. It is advisable to have a periodical renewal of supporting cable. Tube carriers should be locked when not in use. One hand should firmly grasp the tube carrier when the latter is unlocked and over a patient.—*J. D. Camp.*

Wasson, W. Walter. The incipiency of disease. *Radiology*, July, 1929, *13*, 29–34.

The author presents certain facts to be considered when one thinks of the incipiency of disease, namely, hereditary conditions, including both anatomical variations and environment; the great factor of combat to be encountered by the individual immediately upon his birth; infection of many types which actually takes place as early as the first few weeks of life; the similarity of the pathology laid down by this infection to the pathology found later in adults, and its progressive character; and the fact that histories of intelligent adult patients date the beginning of their chronic ailments back to childhood. He concludes that almost all chronic diseases are steadily progressive conditions, with their incipiency in infancy or childhood and their end-results in adult life. He feels that many of the diseases of infancy are being overlooked, and that the roentgenogram has made studies of them possible, yet that the interest in this field has not yet begun.—*J. D. Camp.*

ROENTGEN AND RADIUM THERAPY

Druckmann, Adolf. Sleepiness from roentgen irradiation. *Strahlentherapie*, 1929, *33*, 382–384.

In 1925 a large number of children were given irradiations of the head with hard rays for trichophytosis. After six to eight weeks some of the children showed signs of brain reaction. They were apathetic, constantly sleepy, it was hard to awaken them from sleep and they had no appetite. Often they fell asleep sitting or even standing. A few of them complained of headache and many of them when the sleepiness began had a temperature of 38.5° C. This condition lasted in mild cases four to six days, in severe ones fourteen days and then disappeared completely; while it lasted the children were constipated. The urine and blood were normal. In a few cases there was increased pressure of the spinal fluid. As a result of these cases the tension was reduced and less penetrating rays used. Since then there have been no further signs of cerebral reaction. —*A. G. Morgan.*

Berven, Elis, Heyman, J., and Thoraeus, R. The technique in the treatment of tumours at Radiumhemmet, Stockholm. *Acta Radiol.*, 1929, *10*, 1–71.

This work, which can hardly be briefly summarized, describes the principles and technique used in treating tumors at Radiumhemmet. The strength, quantity and filtration of the active substances used in radiotherapy are discussed. The chief methods of treatment used are with gamma rays, which are hard to filter, and roentgen rays, and combinations of these. They are used not only alone but before and after operation in surgical cases. In the latter cases electro-endothermal treatment is also extensively used.

A brief historical review of the development of the technique is given for each group of diseases, and a detailed description of the treatment or combination of treatments used at Radiumhemmet. The technique used is by no means to be considered final. It is still in process of development and progress is being made especially by the introduction of distant treatment with radium. The technique in use at present is the result of twenty years' uniformity in administration and observation of

the results obtained by treatment at Radiumhemmet.—*A. G. Morgan.*

Collin, Edv. Radiation therapy in the treatment of some common benign and malignant tumors; with particular reference to the results obtained at the Radium Center in Copenhagen. *Acta radiol.*, 1929, *10*, 186–209.

A general survey is given of the cases treated at the Radium Center at Copenhagen, and of the results of their treatment, more particularly the cases from 1920–1924. The importance of long observation time and uniform technique as the only sound basis for a correct estimate of the results is trongly insisted on. The material is divided into benign and malignant tumors and the comparative values of roentgen and radium treatment of the various tumors in each group discussed; epitheliomata, for instance, which are resistant to roentgen treatment are susceptible to radium.

A separate chapter is devoted to the technique used in treating tumors at different sites and a tribute paid to Forssell's influence in radium treatment in Denmark.—*A. G. Morgan.*

Carling, E. Rock, and Leslie-Spinks, A. J. Radium teletherapy; clinical experience with the temporary "bomb." *Brit. M. J.*, Aug. 3, 1929, *2*, 180–183.

This paper is a report of the results obtained in the first 50 cases treated with the temporary "bomb" which was described fully in a previous communication published in the *British Medical Journal*, May 11, 1929, p. 845. The authors describe the difficulties that present themselves in the selection of cases for such therapy, the frequent occurrence of metastatic growths after the disappearance of the initial lesion, and the causes of unsuccess. Their conclusions in the treatment of the first 50 cases follow:

1. Cases of carcinoma of the tongue and mouth treated for local or glandular extensions have done badly; they were in any case hopeless failures of other methods. There has been temporary improvement, but the effect has been limited to slight delay in downward progress.

2. The larynx and esophagus cases have been the most satisfactory; they hold out definite hopes of success when the best dosage has been ascertained.

3. The esophagus is beyond the range of such therapy unless the postcricoid growth be included, but it belongs in this respect to the previous group.

4. The uterine and ovarian cases were failures, but were all the subject of extensive abdominal invasion.

5. Of the renal cases the same must be said—the results are merely palliative.

6. Breast recurrences can be kept in check, even when very extensive, but previous deep roentgen therapy may be a formidable handicap.

7. Vulval glandular extensions do not prove nearly so sensitive as the primary growth.

8. Osteogenetic sarcomata have not shown more than quite temporary recession; other round and spindle cell growths are more promising.—*R. S. Bromer.*

Neeff, Th. C. Dosage in radium and in combined radium-roentgen radiation. *Strahlentherapie*, 1929, *33*, 253–262.

In spite of numerous reports on radium dosimetry in the literature, the author feels that dosage in radium and roentgen radiation is not uniformly standardized. He therefore attempts first to redetermine the skin unit dose in milligram-element-hours for standardized radium capsules; he correlates these doses with the international r-unit. These doses are combined with r-doses used in roentgen therapy and numerous tables and examples illustrate their use in gynecological radiation therapy. Special attention is called to the various factors which determine the total dose, and also the tolerance dose at various parts of the irradiated tissue, especially of the intestines.—*O. Glasser.*

Freund, Franz. Roentgen irradiation to prevent inflammation. *Strahlentherapie*, 1929, *33*, 375–379.

The author in collaboration with Fukase performed a number of experiments to determine whether roentgen irradiation is effective in preventing inflammation. The experiments showed that when the skin of the abdomen of rabbits was incised and a part of the wound irradiated, the irradiated part healed by first intention while non-irradiated parts healed by second intention with granulation. The inhibition of inflammation was shown macroscopically on the irradiated side by the smaller amount of

exudation and the edges of the wound had closed on the fifth day while they were still gaping on the non-irradiated side. In irradiation immediately after fractures the amount of callus formed on the irradiated side was less but the callus was denser and calcified more quickly and consolidation was attained sooner on the irradiated than on the non-irradiated side. Microscopic examination in cases in which the fibulas of rabbits were fractured and irradiation given immediately showed that the initial traumatic inflammation which always initiates fracture healing was decreased by the irradiation. The proliferation of the irritated periosteal cells was partly suppressed in this way so there was less formation of callus and final structural union of the bones was brought about sooner on the irradiated side.

The corneas of frogs were cauterized with a glass instrument and one side immediately irradiated. On the irradiated side the cautery wound remained strictly circumscribed while on the non-irradiated side an areola of infiltration formed.

Children with intense tuberculin reactions were given inunctions of tuberculin and a part of the field irradiated with a dose of 6 H (300 R). In the irradiated region there was no tuberculin reaction or it was very weak.

A number of other experiments in the prophylaxis of inflammation are being carried out. The results so far justify the use of irradiation clinically in the prophylaxis of inflammation.—*A. G. Morgan.*

Sutejew, G., Utenkow, M., and Zeitlin, A. Beitrag zur Ätiologie, Röntgendiagnose und Röntgentherapie der Blastomykose. (Contribution to the etiology, roentgen diagnosis and roentgen therapy of blastomycosis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, September, 1929, *40*, 475–483.

A case of blastomycosis (the *Monilia interposita* type) occurring in a woman twenty-six years of age is described in detail. The condition which lasted for a period of one and a half years and which started with subcutaneous nodules in the region of the right cheek ultimately extended to the left clavicle, to the left ulna, to the diaphysis of the fourth metatarsal and to the left lung. The roentgenograms showing the changes are included. The diagnosis was made microscopically from the pus obtained from the right maxillary sinus.

The changes within the chest consisted in a dense opacity of the entire left lung field similar to that seen in actinomycosis, whereas in the bones they were characterized by areas of rarefaction without evidence of bone new formation.

For a period of a month patient received roentgen treatment. All areas affected were irradiated with one-third skin unit dose by using the following technique. Neo-Intensive Metro tube, 4 ma., 180 kv., 30 cm. skin target distance, fields 5 by 5 cm., 6 by 8 cm., and 10 by 15 cm. (according to the region of the body irradiated), 0.5 mm. Zn plus 1 mm. Al.

Shortly following the roentgen treatment there was improvement in the condition, and within a few months a complete healing ensued. The case is described since it represents a typical condition of Monilia mycosis and since it responded favorably to roentgen therapy. The opinion is expressed that other forms of blastomycosis may lead to similar results.—*T. Leucutia.*

Schneider, G. H. Dosage and technique in dermatological roentgen therapy. *Strahlentherapie*, 1929, *33*, 181–185.

The author recommends a series of three single doses of ⅛ of a skin unit dose in the treatment of eczema and psoriasis. He calls special attention to the care of the skin during the radiation treatment and offers the following formula for a radiation salve:

Rp. Sal. sedativ.		
Hombergil	1	per cent
Olei olivar	36	per cent
Cer. abl.	4.2	per cent
Adipocer. cet.	4.8	per cent
Cosmolin	39	per cent
Aquae dest.	15	per cent

A request to indicate doses in per cent of skin unit doses in dermatological roentgen therapy is made.—*O. Glasser.*

Martenstein, H., and Jung, G. Radiotherapy of scleroma, with a discussion of scleroma in Silesia. *Strahlentherapie*, 1929, *33*, 206–220.

So far as the authors know 36 cases of scleroma have been seen in Silesia since 1879; up to 1918 they all came from a focus in upper Silesia that now seems to be extinct, while since 1921 the cases seem to indicate that a new focus has developed in the Liegnitz region.

Histories are given of 9 of the authors' cases treated from 1902 to 1928 with roentgen rays, or in a few cases with roentgen rays combined with radium or mesothorium. The technique has been changed so frequently that no uniform technique can be given. It seems very questionable whether permanent cure of scleroma can be brought about by irradiation as there was recurrence in some of these cases. In one case there were a series of recurrences at different places on the mucous membranes which however yielded to renewed irradiation. The factors on which the success of irradiation depends are not known at all. Neither the technique used, the age of the patient nor the extent of the scleroma seems to be decisive. One of the authors' best results was in the early days with an apparatus that would not now be considered at all adequate. They did not find that the use of radioactive substances improved the results of roentgen treatment to any appreciable extent. Though the treatment was continued in some cases for years with comparatively large doses they never say any injury from either roentgen or radium irradiation, not even in the larynx. A perforation of the septum in one case was without doubt due to the scleroma itself.—*A. G. Morgan.*

Coutard, H. Roentgen treatment of epithelial cancers of the tonsil region. *Strahlentherapie*, 1929, *33*, 249–252.

From 1920–1926 the author treated 46 cases of epithelial cancer of the tonsil region. As this form of cancer is not painful the patients often come late for treatment; swelling of the glands frequently brings them to the physician. Thirty-four of the patients have either died or are in such condition that it is probable they will soon die. Twelve of them are alive and free of signs of cancer; the time since operation in these 12 cases is from eighteen months to seven years. The total number of cures therefore is 26 per cent. Of these 12 patients 3 were given supplementary treatment with radium and one of these 3 also had a cancerous gland removed by operation. Of these 12 patients 9 had very extensive lesions which extended far beyond the tonsils and the pillars of the fauces and involved the soft palate, uvula and glosso-pharyngeal and glosso-maxillary sinuses; in 3 cases the lesions were not so extensive.

With the exception of the year 1921 when 2 of the patients were treated with moderately penetrating rays (27 cm. spark gap and 12 mm. aluminum filter) they were treated by the following technique: 180 kv., 1.5 to 2 mm. zinc, 40–50 cm. focus skin distance, 100–250 sq. cm. fields, dose of 50 to 150 Holzknecht units (12,500–36,500 French R), depending on the extent of the lesions and the degree of involvement of the lymph glands. Two transverse fields were used in the simple cases and 4 to 6 fields in the difficult cases, with a total duration of irradiation of fifteen to thirty hours. The duration of treatment was fourteen to forty days, longer in some cases than the time considered best by the Paris Radium Institute (fifteen to twenty days).

If the roentgen epithelitis of the mucous membranes and the epidermitis persisted too long they caused early or late edema, telangiectases, atrophy and decolorization of the skin, early or late necrosis of the skin or more rarely of the mucous membranes. Necrosis of the lower jaw is a possible complication of roentgen treatment of carcinoma of the tonsil. It need not necessarily appear immediately after the treatment but may become evident later on extraction of a tooth. The author saw this complication in 2 cases; in one a tooth was extracted fifteen months after the treatment and the osteonecrosis caused death in six months; in the other a tooth was extracted four and a half years after treatment, several sequestra were discharged and the patient recovered.

There were sometimes heart disturbances as immediate general complications (rapid pulse, arrhythmia, fall of blood pressure, hyposystole). These complications were only seen when large fields were used. There were never any changes in the blood picture.—*A. G. Morgan.*

Amalric. Cancer de l'amygdale avec adénopathie traité par radiothérapie pénétrante et guéri depuis 17 mois. (Cancer of the tonsil with adenopathy treated by deep roentgen therapy and healed for a period of seventeen months.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 200–201.

A case of carcinoma of the right tonsil, with extensive metastases to the adjacent lymph nodes, is described in a man sixty-six years of age, which was cured by an application of deep

roentgen therapy. The treatment which was carried out between Nov. 28 and Dec. 30, 1927, consisted of ten sittings of irradiations, a total dose of 5300 R (half on the right and half on the left) having been administered with 200 kv., 2.5 ma., 0.5 mm. Cu and 2 mm. Al filters, 40 cm. skin target distance, two ports of entry (one right and one left), and 8 by 10 cm. fields.

In connection with this it is emphasized that carcinomas of the tonsil as a whole are rather sensitive to radiation and that deep roentgen therapy constitutes the method of choice.—*T. Leucutia.*

HUET, J.-A., and SOBEL. A propos de la radiothérapie de l'asthma. (The radiotherapy of asthma.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 169–171.

Six cases of bronchial asthma treated by irradiation of the tracheobronchial lymph nodes are briefly described.

The technique of exposure was as follows: Two posterior ports of entry, one cervical, 8 by 10 cm. in size (including the last cervical and the first dorsal vertebrae), and one interscapular also 8 by 10 cm.; two anterior ports of entry with parasternal crossfiring; 25 cm. spark gap, 2.5 ma., 30 cm. skin target distance, 5 mm. Al, 500 R per field, the two posterior fields being irradiated first and the two anterior fields three days later. An improvement was observed following the fourth to sixth sitting, and a healing ensued following the eighth sitting. Not more than 2000 R was administered per field.

The cases described have remained free of symptoms for a period of over two years. A series of other cases was also treated but not sufficient time has elapsed to declare them healed.—*T. Leucutia.*

DENIER. Contribution à l'action thérapeutique des rayons de Bucky sur les viscéralgies. (Contribution to the therapeutic action of the Bucky rays in visceralgias.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 178–181.

Bucky rays were administered in several abdominal conditions associated with marked pain (one c se of pyloric spasm due to cholecy case of epigastric pain in tuberculosis, and one case of salpingo-ovaritis) as well as in a case of Raynaud's disease, and it was found that there was a disappearance of the pain soon after the application of the rays.

In connection with this the theories of Head, MacKenzie and Verger with regard to the origin of pain in visceral diseases are discussed and the conclusion is reached that the Bucky rays (which must be given in a dose corresponding to a full erythema dose) lead to a vasodilatation of the irradiated area. The vasodilatation which begins the second day following the treatment and lasts for a period of fifteen days acts as a counterstimulus modifying the disturbed sensation and thus reestablishing the normal functional equilibrium of the viscera.—*T. Leucutia.*

v. WIESER, W. Further experience in the roentgen treatment of psychiatric and neurological diseases. *Strahlentherapie*, 1929, *33*, 380–381.

Three cases of severe post-encephalitis symptoms in children and 2 in adults are described; they were cured or greatly improved by irradiation of the skull with small doses of roentgen rays.—*A. G. Morgan.*

DANNREUTHER, WALTER. Radiotherapy in the treatment of cancer of the cervix. *Am. J. Obst. & Gynec.*, April, 1929, *17*, 524–527.

The author believes that radium is the most efficient single therapeutic agent in the treatment of cancer of the cervix and that the variations in the technique of its use are relatively unimportant, providing an ample amount of radium is used, the screenage is correct and the dosage is sufficient. He advises the use of slender intrauterine applicators and the intramural implantation of needles as well as supplementary roentgen therapy.

Combined radium therapy and operative treatment is of value in occasional selected cases. He believes that the popularity of radical hysterectomy abroad is due to the concentration of the radium supply in a few institutions.

The contraindications to intensive radiation therapy are: patients with metabolic impairment, pelvic suppuration or hopelessly advanced cancer. He deplores the indiscriminate distribution of radium apparatus to the profession in general, having observed cases whose chances for recovery have been lessened by

the improper use of such radium by those of little or no experience.—*P. A. Bishop.*

Stevens, J. Thompson. The management of carcinomata of the uterine cervix. *Radiology*, May, 1929, *12*, 423–428.

In the early paragraphs of the paper considerable clinical data are given, including the clinical classification for the study of malignant diseases of the uterine cervix; the pathologic types encountered are enumerated, together with the site of the primary lesions of the various types, and the pathologic histology is reviewed. The methods of eradicating infections associated with malignancies of the uterine cervix are outlined. The plan and technique of roentgen and radium therapy are given at some length. Electrothermic procedures are mentioned, and advised. Clinical conditions following preliminary roentgen irradiation are described. The prognosis and results obtained by the plan and technique of the treatments advised are given. The author concludes that the treatment of carcinomata of the uterine cervix with roentgen rays, radium, and electrothermic surgery is past the experimental stage; that the plan and technique of treatment are rapidly becoming standardized as shown by the agreement of various authors, and that no other method of treatment to date has even approached the results obtained by those who are engaged in the radiation treatment of this malady.—*J. D. Camp.*

Bland, P. Brooks. Pyometra following radium therapy for uterine cancer. *Am. J. Obst. & Gynec.*, April, 1929, *17*, 528–536.

Pyometra is defined as cervical atresia with retention of infected material within the uterine cavity. That its occurrence is becoming increasingly frequent since the use of radium in the treatment of carcinoma of the cervix is the experience of the author as well as contemporaries in this and other countries.

Postirradiation fibrosis followed by contraction and cohesion or fusion of the walls is the causative factor. Fluid accumulation is from associated inflammatory changes of the endo- and myometrium. Usually the condition develops slowly and does not give rise to symptoms before three to six months.

The symptoms depend on the type of atresia. In the partial or incomplete type there are periodic attacks of mild pelvic pain due to the efforts of the uterus to expel the retained material, and an offensive purulent discharge. The discharge is at times tinged with blood but not constantly so as in the discharge accompanying uterine carcinoma. The pain subsides after expulsion of the material.

In the closed type, hypogastric pain and increased size of the uterus, together with varying degrees of systemic phenomena of septicemia are the principal features. The distress ceases after spontaneous evacuation of the accumulated material.

The diagnosis is made from a clinical history of cervical irradiation in a patient complaining of a purulent discharge, not constantly blood tinged, especially if associated with attacks of intermittent pain. The size of the uterus will depend on the duration of the obstruction.

The treatment in the incomplete cases is dilatation or catheterization of the uterus. This is usually sufficient to effect a cure. In the complete cases hysterectomy is necessary. —*P. A. Bishop.*

Cleland, Frederick A. The radium treatment of fibroids and fibrosis uteri. *Am. J. Obst. & Gynec.*, April, 1929, *17*, 508–516.

The author uses the name fibrosis uteri as a clinical term for those cases in which the uterus is definitely enlarged, having thick dense walls, but no nodules, and in which menorrhagia is the leading feature.

Radium was used in 98 cases with uniformly good results. The dosage was from 1200 to 1500 mg-hr.

In 102 fibroid cases the dosage was from 1400 to 1500 mg-hr. In 9 cases the treatment was unsuccessful.

Abnormal bleeding was present in all but 3 of the 200 cases. It was controlled with one treatment in 95 per cent of cases. Climateric symptoms were not abnormal. The size of the fibroids and uterus was decreased.

The author's contraindications to the use of radium are: (1) fibroids larger than a three and a half months pregnancy; (2) the presence of adnexal disease; (3) symptoms suggesting degeneration of the fibroid; (4) subperitoneal fibroids; (5) surgical treatment is usually advisable in young women and those in whom other abdominal operation is indicated.

He concludes by stating as an absolute rule

that a diagnostic curettage be done in every case of uterine bleeding before the application of radium.—*P. A. Bishop.*

TOOMBS, PERCY W., The effects of x-ray and radium upon the fetus in utero. *Am. J. Obst. & Gynec.*, April, 1929, *17*, 516–523.

A review of the literature is given, after which the author makes the following conclusions: (1) Diagnostic exposure is not harmful unless resorted to too frequently. (2) Therapeutic exposure causes abortion in the early months and various deformities of the eyes, brain and cord during the later months. (3) The severity of dosage and period of fetal development determine the particular reaction of the individual fetal tissues, the younger the embryo, the greater the injury. (4) Malignancy superimposed upon pregnancy demands measures sufficient to destroy cancer, the life of the fetus, of course, being disregarded. (5) In obscure cases, pregnancy and fibroids coexisting, and in elderly women, the probability of pregnancy should always be kept in mind in order to avoid subjecting the supposedly absent fetus to immediate death or to something worse.—*P. A. Bishop.*

STACY, LEDA J., and MUSSEY, ROBERT D. Radium in the treatment of menorrhagia of adolescence and of the menopause. *Am. J. Obst. & Gynec.*, April, 1929, *17*, 502–508.

A series of 15 cases of metrorrhagia and menorrhagia of adolescence were treated with varying doses of radium, only after all medical treatment had failed and more radical treatment seemed inadvisable. The results in this small group were not constant. The dosage varied from 100 to 700 mg-hr. A table is given showing the details of dosage and results.

During or near the menopause the conservation of ovarian function was disregarded and sufficient radium was used to produce permanent cessation of menstruation. A series of 244 cases of this class was treated with doses ranging from 250 to 1500 mg-hr.

The conclusions of the authors are: (1) In the adolescent period, radium should not be used until after all general and other accepted measures of treatment have failed. The dose should be small enough to preclude any possible injury to the ovary. They believe that not more than 200 to 250 mg-hr. should be used in the initial treatment. (2) It is evident that the use of radium is of distinct value in controlling menorrhagia of the menopause. (3) From 800 to 1000 mg-hr. of intrauterine radium in a single dose gives satisfactory results in more than 90 per cent of patients treated. (4) The history of pelvic infection even eight or ten years previously, or evidence of pelvic infection is a definite contraindication to the use of radium. (5) Preliminary curettage for diagnostic purposes should be carried out in practically all cases in which the patient is more than forty years of age.—*P. A. Bishop.*

FORD, FRANCES A., and DRIPS, DELLA G. Clinical and experimental studies of low dosage irradiation of the ovaries and hypophysis in menstrual disorders. *Radiology*, May, 1929, *12*, 393–402.

The authors state that irradiation of ovaries or hypophysis has been effective in re-establishing menstruation in patients in whom prolonged use of organotherapy had been ineffective. A conclusion cannot be drawn as to the comparative efficiency of methods, because the cases selected for irradiation were of unusual severity. Irradiation of the hypophysis, occasionally combined with splenic and hepatic irradiation has exerted a temporary regulating effect in 7 cases of severe menorrhagia and metrorrhagia; with supplementary treatment, the effect in 2 cases has persisted more than one year. Relief of dysmenorrhea has been incidental in certain cases of menorrhagia and oligomenorrhea. Of 6 cases treated primarily for dysmenorrhea, relief has been complete in 3 and has lasted for a period of four to six months; improvement occurred in 2 others. Irradiation of ovaries of white rats in various dosages has resulted as follows: There was no continued influence on the regularity of the estrual cycle. Complete destruction of follicles did not result from dosages up to 2.5 skin unit doses (H.E.D.). There was no influence on fertility, except in cases in which there was marked systemic reaction, with irradiation of 50 per cent unit skin doses or below. With the application of 2.5 skin unit doses sterility has been produced in 5 of 10 rats. In one instance in which the animal was mated eight days after irradiation, a normal litter of nine young was produced. Abortion and maternal death resulted in 2 cases. Abnormality in the progeny has not been demonstrated.—*J. D. Camp.*

Cristol, P., and Puech, A. Études sur la polypeptidémie chez les cancéreux et de ses modifications au cours des traitements curie-thérapiques et radiothérapiques. (Studies of polypeptidemia in cancerous patients and its modification during the course of curie therapy and radiotherapy.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1929, *17*, 207–212.

In 1925 the authors published for the first time their method of determining the polypeptides in the blood serum. The principle of the method is that a 20 per cent solution of trichloracetic acid (according to the technique of Moog) precipitates the albumin of the blood serum, while if the precipitation is done with the use of phosphotungstic acid (according to the authors' own technique) the polypeptides are also precipitated. The difference in the total nitrogen of the two filtrates indicates the amount of polypeptides in the serum.

The method was used: (1) in cancerous patients without any treatment; (2) in cancerous patients following application of curie therapy, and (3) in cancerous patients following roentgen therapy.

(1) The number of untreated cancerous patients was 26, the lesions comprising cancers of practically every location of the body. In 14 per cent the amount of polypeptides was normal (from 0.002 to 0.025 per thousand). In 72 per cent it was slightly increased (0.030 to 0.070 per thousand), and in the other 14 per cent it was greatly increased (0.070 to 0.150 per thousand). (2) Following curie therapy (8 cases) the polypeptides increased from 0.048 per thousand to 0.060 per thousand. (3) Following roentgen therapy (11 cases) the increase was from 0.037 to 0.098 per thousand.

The conclusion is reached that the amount of polypeptides present in the blood serum of cancerous patients is above the normal. The increase is rather great in cachectic individuals, and in cases with a rapid progression of the tumor, or with hepatic and renal complications.

Following curie therapy, there is a slight, while following roentgen therapy there is a very marked increase of the polypeptidemia above the values observed previous to the treatment.

Since polypeptides are intermediary products of the protein metabolism, their appearance in the blood in a larger amount indicates increased proteolysis.—*T. Leucutia.*

MISCELLANEOUS

Holzknecht, Guido. Die Entwicklung der Röntgenkunde. (Development of roentgenology.) *Klin. Wchnschr.*, July 2, 1929, *8*, 1241–1243.

The development of roentgenology passed through two stages, the first one in which only diagnosis of fractures and foreign bodies was possible and a second one in which with the aid of contrast media it was extended to diseases of all organs and in which roentgen treatment of tumors and inflammatory diseases developed. In the first period of the study of fractures and foreign bodies the technique was difficult and diagnosis easy. In the second technique has become easier and easier and diagnosis more and more difficult. Now any physician can learn the technique in six months but diagnosis is so difficult as to border on the impossible. And in spite of pride in what has been accomplished it must be admitted that much more remains to be done.

As suggestions in such accomplishment the author advises leaving all questions of technique to physicists, technicians and industrial establishments and keeping diagnosis and treatment in the hands of physicians. And within these fields there must be intense specialization. After a scientific field has once been thoroughly mastered anyone can learn what has been done in a little while, but in a new field like that of roentgenology where new facts are constantly being discovered it is necessary to specialize. Many special fields have already developed in roentgenology, as for instance the diagnosis of the skull (eyes, ears, nose, nervous diseases; it is by far the most difficult field in diagnosis;) the study of the teeth and jaw, the esophagus, heart and vessels, tumors of the thorax, tuberculosis and other lung diseases, diseases of the urinary tract, the female genital organs, the bones and joints. And in treatment that of new-growths, inflammations, trophic diseases and endocrine diseases. When a man has become undisputed master in his field he should put forth every effort to make his knowledge available to others.

A second necessity is a thorough investigation and understanding of fundamentals, such for instance as a knowledge of what things in the picture are due to technical and photographic causes, what are normal and what

caused by variations in age and constitution, so as to know definitely just what is pathological. The biological action of the rays must be understood and their effects on normal and pathological tissues; in short a thorough knowledge of roentgen physics, roentgen anatomy and physiology and roentgen biology. The most essential things in further development therefore are thorough fundamental knowledge, specialization and exchange of knowledge. Some workers have held that since there are so many special fields in roentgenology they should simply be absorbed in the other medical specialties and each specialist in medicine become a specialist in that field of roentgenology too. But that is impossible as the fields of medicine and of roentgenology do not coincide. For instance, roentgen diagnosis is a special field aside from roentgen therapy and this is never true in medicine. Other examples of the discrepancy in medical and roentgen specialties are cited and the question of the best method of disseminating knowledge of roentgenology discussed. This will probably have to be accomplished chiefly by roentgen institutes for the universities are so concerned with teaching what is already known that they have little time or inclination for exploring new fields.—*A. G. Morgan.*

GAY, PAUL. Une grille d'ortho-radioscopie. (A grid for orthoradioscopy.) *Bull. et mém. Soc. de radiol. méd. de France*, April, 1929, *17*, 140-142.

As is known the grids of the Bucky diaphragm are arranged so that they fall in the direction of the rays hitting that particular spot of the diaphragm, that is they are arranged concentrically around a tube, the focus grid distance of which is 70 cm. It is obvious that such a diaphragm is of little value in orthodiagraphy where the central beam has to follow exactly the border of the heart. The author constructed a diaphragm with the grids strictly parallel (that is, without focal inclination of the grids) so that the central ray which is moved about the border of the heart may fall in the direction of the grid at that particular point.

Such a diaphragm while of great aid in the examination of one particular portion of the heart cannot be used for the roentgenoscopy or roentgenography of the entire ensemble of the heart.

The greatest value of this grid lies in orthodiagraphy in the oblique position (study of the auricles and ventricles in oblique position) where the detail without the grid is very meager.—*T. Leucutia.*

ROFFO, A. H., and CORREA, L. M. Über den Vorgang der Cholesterinzerstörung in vitro durch die Röntgenstrahlen. Versuche mit Chloroform, Tetrachlorkohlenstoff und Methyljodid. (On the mechanism of cholesterin destruction in vitro by roentgen rays. Experiments with chloroform, carbon tetrachloride and methyl iodide.) *Strahlentherapie*, 1929, *33*, 537-541.

In 1924, the authors first published their investigations on the effect of the roentgen rays on cholesterin in vitro. Since that time numerous experiments have been carried out by various investigators with the idea of determining the exact mechanism of the destruction of the cholesterin by the roentgen rays and the part different solvents take in this process. In the present article the authors discuss the effect of the roentgen rays on pure chloroform, carbon tetrachloride and methyl iodide solutions, on the one hand, and on cholesterinized chloroform, carbon tetrachloride and methyl iodide solutions, on the other hand.

It was found that roentgen rays have a direct effect on pure chloroform, carbon tetrachloride and methyl iodide solutions leading to a decomposition into HCl and Cl; HCl and C, and HI and I respectively, as for example: $3Cl_3CH$ + roentgen rays + o → $3HCl + Cl_4C + Cl_2CO + C$, and Cl_4C + roentgen rays + o → $Cl_2OC + Cl_2$. The Cl_2 acting on the water produces $H_2O + Cl_2 \rightarrow 2HCl + O$. (The same process takes place with Cl_4C and ICH_3.)

In the cholesterinized chloroform, carbon tetrachloride and methyl iodide solutions the oxygen liberated by the action of the roentgen rays acts on the cholesterin molecule producing oxidation and thus disintegration into substances the nature of which is not as yet exactly determined.

Thus the conclusion is reached that the effect of roentgen rays is primarily on the chloroform, carbon tetrachloride and methyl iodide leading to liberation of free Cl and I, which in turn act as oxidizing agents on the cholesterin molecules.—*T. Leucutia.*

Colanéri, L.-J. Les propriétés biologiques des rayons de 4 à 8 angströms. (The biological properties of rays of 4 to 8 Ångströms.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1929, *17*, 100–105.

The Institute of Actinology, the purpose of which is to study radiations which lie between the roentgen rays used for diagnostic purposes (1 Å) and the ultraviolet rays utilized in actinotherapy (2000 Å) has recently experimented with roentgen rays of 4 to 8 Å.

As is known, Dauvillier constructed a tube by replacing the Lindemann window of the Bucky tube with a very thin (1/200 mm.) cellophan window which permits the emission of very soft roentgen rays of a wave length from 4 to 8 Å. Saidman, in determining the biologic and therapeutic action of these rays, found that an early erythema is produced within forty-eight hours following the irradiation and that this erythema reaches its peak within two to four weeks. According to Saidman and Cahen the early erythema is due to the very long rays (in the vicinity of 8 Å) while the late erythema is the result of the roentgen rays of very short wave length (in the vicinity of 4 Å). The erythema is more or less pruriginous and is followed by pigmentation. Enormous doses can be given without producing any serious injury to the skin.

Since there is as yet no practical method of measuring this very soft radiation, the energy administered is designated by milliampere-minutes (the irradiated skin being at a distance of 5 mm. from the window). The usual doses vary between 20 and 1000 ma-min. and the tolerance of the skin is as high as 5000 to 6000 ma-min.

The experiments in the treatment of different skin conditions (eczema, psoriasis, certain alopecias, etc.) will be published later by Saidman.—*T. Leucutia.*

Politzer, G., and Pauli, W. E. Über die biologische Wirkung der Kathodenstrahlen. (The biological effect of cathode rays.) *Strahlentherapie*, 1929, *33*, 704–710.

Pauli and Hartmann in a previous article studied the effect of the cathode rays on the protoplasm of cells. In the present article the effect on the nucleus at rest and on karyokinesis is investigated. The cornea of the larvae of the *Salamandra maculosa* was used for this purpose. The results of the investigation were published in extenso in *Ztschr. f. Zellforsch. u. mikr. Anat.* Here only the part interesting to roentgenologists is referred to.

The cathode rays were produced by means of a cathode-ray tube provided with a Pauli "exchangeable" window and with an aluminum leaf. The tube was run at 65,000 volts.

The changes observed on the cornea of the irradiated larvae can be classified into three groups: (1) Shortly following the irradiation there is a necrosis of the superficial cells "at rest" characterized by all phases of cellular necrosis. These changes are due to the higher absorption of the superficial layers, of both roentgen and cathode rays and consequently have nothing characteristic. (2) The second form of change is in connection with karyokinensis. A few hours following the irradiation as a result of the primary effect, the asters and partly the later division forms of the nuclei appear highly pycnotic, leading to various forms of mitosis. Within a few hours the cornea becomes entirely free of mitosis. Several days later new abnormal forms of karyokinesis appear which are due to the secondary effect. These changes (primary effect, mitosis-free interval, secondary effect) are, as already demonstrated by Alberti and Politzer, characteristic of the effect of the roentgen rays. The presence of a roentgen effect in connection with the cathode rays is easily understood since some of the cathode rays hitting the tube window or even within the tissues themselves are transformed into roentgen rays. (3) A third form of nuclear injury is observed in connection with the mitosis which consists in the fusion of the chromosomes in the equatorial zone and of a pycnosis of the otherwise achromatic fibers of the central spindle. The fibers also show a considerable thickening as compared to normal conditions and they have a club-shaped ending towards the polar region. This abnormal karyokinesis is observed only following irradiation with cathode rays and consequently can be considered as a characteristic effect of the cathode rays. It is possible that a chemical change occurring in the achromatic substance of the fibers renders them chromatic. It is also possible that the effect of the cathode rays produces fusion of the chromosomes through destruction of their chemical substances, resulting in a diffusion

of some of this substance around the fibers thus rendering them chromatic.

It is to be hoped that this specific effect of the cathode rays on the nuclear substance can be used to advantage for therapeutic purposes. It has long been observed that the application of radium plaques results in certain changes of the nuclear substance which were different from those of the roentgen effect and which could not be explained until now. It appears. that these changes are similar to those produced by the cathode rays and that they are due to the effect of the beta rays of the radium. The specific effect of the cathode rays on the nuclear structure and karyokinesis would negative the theory of the action of the roentgen rays by means of secondary electron emissions since no such changes are observed in connection with the roentgen-ray effect.—*T. Leucutia.*

Brams, J., and Darnbacher, L. The effect of x-rays on the gallbladder: experimental production of cholecystitis. *Radiology*, August, 1929, *13*, 103–108.

A definite acute and chronic cholecystitis was experimentally produced in a series of dogs with of dosages roentgen rays that are within the range of those used for therapeutic purposes. The changes produced are destructive. They consist of hemorrhage, inflammatory edema, round-cell infiltration, fibrous tissue hyperplasia, and, in some instances, necrosis of the epithelium, and resemble the type of cholecystitis produced by chemical means. Basing their opinion on the relative lack of injury to the exposed portion of the duodenal and pyloric mucosa, the authors believe that the gall-bladder epithelium is comparatively more sensitive to roentgen-ray exposure than the other organs in apposition to it. Hence the possibility of injury to the gall-bladder by deep therapy in the region of the right upper quadrant must be borne in mind.—*J. D. Camp.*

Crandall, L. A., and Walsh, E. L. The effect of iodized oils on serous membranes. *Radiology*, June, 1929, *12*, 499–504.

From experiments on dogs, these authors conclude that lipiodol and iodipin are irritating to certain serous membranes. Intrapericardial injection produces pericarditis with effusion, followed by death in about two weeks. Intrapleural injection produces a pleuritis of variable grade; some animals die. Injection into joints produces some inflammation of the capsule. Intraperitoneal injection appears to be harmless. Poppy-seed oil and ethyl brassidate are equally as irritating to the pericardium as their iodine compounds; sesame oil is somewhat less irritating, while olive oil appears to be practically innocuous.—*J. D. Camp.*